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HUMAN ABORTION

BY WILLIAM M. MILLAR, M.D.
From the Department of Surgery, College of Medicine of the University of Cincinnati

INTRODUCTION

HUMAN abortion has at all times been a great question of practical importance. At present the recent experiments in state control as practiced and advocated in the Soviet Republics, the difficult economical conditions of today, and the increasing interest in birth control, have all tended to focus our attention on this subject.

This article contains:

(1) A review of the world's religious and philosophical writings on or about abortions, together with a short discussion on the probable frequency, current methods of treatment, and differential diagnoses.

(2) A statistical study of 2,098 cases admitted to the Cincinnati General Hospital in a period of fifteen years (1918-1932).

Therapeutic abortions have been excluded. All cases which are recorded as over four months' gestation have also been omitted in view of the definition which is taken from the text book of the late J. Whitridge Williams. He defines an abortion as a "pregnancy which terminates before sixteen weeks" and this criterion has been rigorously followed in the preparation of this monograph.

HISTORY

The question of abortion [1] has always been dependent on the relation

[1] The problem and history of the closely allied subject of infanticide has been purposely omitted.

of the individual to the State, the degree of existing poverty of the family group, and the consideration of the rights of the unborn child. Since the beginning of time, nations and their leaders have always desired an increase in population for the very selfish and natural reason that such an addition is needed and can always be used for soldiers and combatants. This wish for civic expansion has always been opposed by the actual existing economic conditions of the family and its ability to support and provide for any great additions to its number. The shift from the recognition of the rights of the social and political group to those of the individual and the unborn child seems to have come about quite slowly. It has been suggested that the moral view may have grown out of the knowledge that such abortive procedures were injurious and sometimes fatal to the mother who was the reproductive portion of the race. Again the invasion of the huge numbers of female workers into all fields of labor which until a short time ago were for men only must certainly have a marked modern influence in the matter. Pregnancy incapacitates wage earners and to this they will not or cannot submit. It is well known that the Roman Catholic Church with its very decided views on baptism and infant damnation has stressed the idea of moral turpitude in connection with the act. In fact there are many who live in the present age who believe that Christianity alone is responsible for the existing moral conception. But this is not entirely true. Criminal stigmatism has been associated with it for thousands of years.

In the sacred literature of the East, one finds frequent mention and moral condemnation of the practice. The ancient Asiatic Writings of Brahmanism (Hindooism), (B. C. 1500-1000), Zoroastrianism (B. C. 1000-600), Tâoism (about B. C. 500), and Buddhism (from B. C. 500 onward) condemn it. To quote several passages:

. . ."(And) Brahman (said) . . . One who drinks spirituous liquors, one who kills a Brâhmana, one who steals, one who destroys an embryo, one who violates the bed of his preceptor is released from that sin only by penance well performed" . . . (Anugita, Chap. xxxvi, 23)[2]

In the Vasishtha (Chapter xx, 23), "We will declare the slayer of a learned Brâhmana 'bhrunahan.' He is called Bhrunahan who kills a Brâhmana or destroys an embryo the (sex of) which is unknown. 24. For an embryo (the sex of)

[2] Probably this was actually written in the Fourth Century B. C. (according to TeLang), although it is argued that it is very much older.

which is unknown becomes male; therefore they offer burnt oblations for the production of males . . ."

In the Vasishtha, Chapter XXVIII, 7, "Those versed in the sacred law state that there are three acts (only) which make women outcasts (viz.), the murder of the husband, slaying a learned Brâhmana, and the destruction of the fruit of their womb."

In the Baudhâyana, Prasna IV; Adhyaya 12, speaking of penances, 12: "He who does not give away a marriageable daughter during three years doubtless contracts a guilt equal to that of destroying an embryo . . ."

14. "Three years let a marriageable damsel wait for the order of her father. But after that time let her choose for herself in the fourth year a husband (of) equal (rank). If no man (of) equal (rank) be found, she may take even one destitute of good qualities . . ."

20. "Let him proclaim in the village a wife who, being obdurate against her husband, makes herself sterile as one who destroys embryos, and drive her from his house."

In the Vedic sacrificial rites the Satapatha-Brahmana. III Kana 1, Adhyaya 2, Brahmana 21. "Such a one as . . . 'he (who) hath expelled an embryo from a woman, (and) hath committed a sin,' let him therefore not eat (the flesh) of the cow and ox."

Laws of Manu. "Libations of water shall not be offered to those . . . women who have joined a heretical sect, who through lust live (with many men), who have caused an abortion . . ."

XI, 88: "Penance is required for destroying the embryo (of a Brâhmana, the sex of which) is unknown . . ."

Gautama, XXII: "Penances must be done . . . also for destroying the embryo of a Brâhmana though its sex may not be distinguishable . . . (He can and shall) emaciate himself and then throw himself into a fire or become a target for armed men in battle, save life of a Brâhmana, or if he is thrice vanquished in trying to recover property of Brâhmana stolen by robbers (he will then be excused)."

Mahâvagga 1, 78: 4. . . . "A Bhikkhu who intentionally kills a human being (in order) to procure abortion, is no Samany and no follower of the Sakyaputta" . . . (Admission to the order of Bhikkhus—Buddhist monks)

(Parsi) Yast and Sirozah, X, 54: "And the great Ashi Vanguhi said: 'None of those libations will be accepted by me which are sent to me either by a man whose seed has dried out, or by the courtezan who produces untimely issues (by procuring abortion) or by young boys, or by girls who have known no man . . .'"

Vistâsp Yast (Zoroaster) IV, 29: "That man does not follow the way of the Law, O Zarathustra, who commits the Boodhô-(Varsta) crime with a damsel and an old woman (to produce miscarriage)."

Texts of Tâoism. The Thâ Shang. Tractate of Actions and Their Retributions. (Actually written perhaps in the Eleventh Century A. D.)

4. "(He who) . . . kills newly born children or brings about abortions . . . . In the case of crimes such as these (the Spirits) presiding over life according to their lightness or gravity, take away from the culprit periods of twelve years or of

one hundred days. When his term of life is exhausted, death ensues. If at death there remains guilt unpunished, judgment extends to his posterity."

The Zendavesta of the Parsees records that about 400 B. C. there was a tremendous epidemic of poisoning from rye ergot. Almost every woman who was pregnant at the time is said to have miscarried by reason of the "noxious gases that cause pregnant women to drop the fruit of their womb and die in childbirth."

Bloomfield (in the *Proc. Am. Or. Soc.* for Mar. 1894; *Journal,* Vol. XVI, p. CXIX) in talking about "Trita, the scapegoat of the gods," writes and translates: (At Maitr. S. IV, 1, 9.) "It is stated that the gods did not find a person upon whom they might wipe off from themselves the bloody part of the sacrifice, i. e., their guilt. Agni spat upon the waters and successively three personages, Ekata, Dvita, and Trita were born. The gods wiped off their guilt upon them; they in turn wiped themselves upon one who was overtaken by the rising sun, i. e., upon one upon whom the sun had risen while he was asleep; this one wiped himself upon one who was overtaken by the setting sun; he upon one afflicted with brown teeth; he upon one with diseased mark; he upon one that had married a younger sister before the older was married; he upon one whose younger brother had married before himself; he upon one who had married before his older brother, he upon one who had slain a man; he upon one who had committed an abortion. 'Beyond him who has committed an abortion the sin does not pass'."

Assyrian: There is no mention of abortion in the Code of Hammurabi (B. C. 2100).

Egyptian: The Edwin Smith Papyrus (B. C. 1600) contains no actual mention of abortion but in the George Ebers Papyrus (circa 1550 B. C.) there are at least two prescriptions for inducing abortion (Plates 93:6 and 94:11). In the Kahun Papyrus of the Petri collection (1100 B. C.) uterine bleeding is discussed which in the broadest sense might be interpreted as abortion. But this certainly is none too definite.

Greece: The Greeks, of course, practiced abortion.

Socrates, B. C. 469-399, (In Plato's Theaetetus) is quoted as saying about midwives: "By the use of potions and incantations they are able to arouse the pangs and to soothe them at will. They can make those bear who have a difficulty in bearing and if they think fit they can smother the embryo in the womb."

Plato (B. C. 400) advocates it strongly as a means of perfecting the body politic: ". . . And we grant all this accompanying the permission with strict orders to prevent any embryo which may come into being from seeing the light, and if any force a way to the birth, the parents must understand that the offspring of such an union cannot be maintained and arrange accordingly."

Again we read: "No child (should) come into the world with mother above forty or father above fifty."

On the other hand, Hippocrates (B. C. 460—B. C. 377) felt so strongly on the subject that he incorporated in his famous oath: "Similarly I will not give to a woman a pessary to cause abortion. . . ." He was also aware of the fact that

abortion could come from other than artificial reasons, such as epidemics, for we read elsewhere:

"I know of no woman who died if any of these symptoms showed themselves properly, but all to my knowledge had abortions if they chanced to fall ill when with child."

"The women are unhealthy and subject to excessive fluxes. Then many are barren through disease and not by nature while abortions are frequent. . . ."

Pericles' mistress, the famous Aspasia, (circa 450 B. C.) is said to have taught it. Lycurgus (circa B. C. 800) and Solon (B. C. 600) are declared to have prohibited it while Musonius (it is said) in a quotation preserved by Stobaeus (A. D. 500) stated that the ancient Greek legislatures forbade their women to practice abortion or even to use contraceptives. (Reinach)

Everyone recalls the story of stoicism about the Spartan youngster who allowed a fox to gnaw out his entrails. But few realize that there is a similar account of courage of the female Spartan. In Plutarch's Moralia we read, "A (certain Spartan) girl had secret relations with a man and after bringing on an abortion she bore up so bravely not uttering a single sound that her delivery took place without the knowledge of her father and others who were near. For the confronting of her indecorum with decorum gained the victory over the poignant distress of her pains."

Celsus (circa 50 A. D.) briefly dismissed the subject but Galen (circa 150 A. D.) wrote: ". . . When everything connected with the pregnancy proceeds properly, the eliminative faculty remains quiescent as though it did not exist but if anything goes wrong in connection either with . . . any of the . . . membranes or with the foetus itself, and when its completion is entirely despaired of, then the uterus no longer awaits the nine month period, but the retentive faculty forthwith ceases and allows the hithertofore inoperative faculty to come into action. . . . Now it is that something is done, in fact, useful work effected by the eliminative or propulsive faculty . . ."

"Now abortifacient drugs or certain other conditions which destroy the embryo or rupture certain of its membranes are followed by abortion. . . ."

Also:

"Both of these conditions (stretching of uterus or irritation) sometimes occur with actual violence and then miscarriage takes place. . . ."

Seneca (4 B. C.-65 A. D.) eulogized Helvia because she did not practice it and Cicero (circa B. C. 50) spoke approvingly of a case where the woman was put to death for that reason. She had, he declared, "robbed the father of the hope and of the memory of his name . . . . deprived the household of an heir, and the state of a citizen."

In Pliny's "Natural History" (77 A. D.) we find definite reasons stated. "Abortion will ensue if the female should happen to sneeze just after the sexual congress . . ."

"The smell of a lamp just extinguished is a cause . . ."

He remarks elsewhere that he knew of a case where twelve embryos were removed at a single abortion (a chorionic epithelioma?) and in order to produce

abortion he cites the method of Olympian, the Theban authoress, who used goose grease mixed with mallow.

The classical Roman literature has an occasional reference on the subject, and we find mention of it in Ovid (B. C. 43—17 A. D.) and Juvenal (circa 100 A. D.) To quote from the former:

> "Now she that wishes to seem beautiful harms her womb
> And rare in these days is she who would be a parent . . ."
> (Nunc uterum vitiat que volt formose videri
> Raraque in hoc aevo est quae velit esse parens . . .")
>
> (Nux, lines 23, 24)

Certain authorities have read abortion into certain lines of Vergil, (B. C. 70—B. C. 19) VI, 426-30:

> "Continuo auditae voces, vagitus et ingens,
> Infantumque animae flentes in lumine primo,
> Quos dulcis vitae exsortis et ab ubere raptos
> Abstulit atra dies et funere mersit acerbo
> Hos juxta falso damnati crimine mortis."
> ("Before the gates the cries of babes newborn,
> Whom fate had from their tender mothers torn;
> Assault his ears; then those whom form of laws
> Condemned to die, when traitors judged their cause.")
>
> *Dryden*

Reinach maintains that "sein" means both mammary gland and womb, and Vergil's "ab ubere raptos" may be taken to mean either "torn from the breast" or "torn from the womb."

In addition to speculation about the actual pathology and physiology the Greeks busied themselves with the ever-enchanting and as yet unsolved question of "when does the soul enter the body?"

Aristotle (circa B. C. 350) held that the cell of the zygote at conception was negative and after a few days an animal soul was infused into it. A little later the "rational" followed. The male soul took this "on" at forty days after conception while the laggard female needed at least eighty.

In more modern times the question of viability became legally important in the definition of murder. Various arbitrary standards were set up and the best of these, perhaps, were the commencement of foetal motion and quickening in utero.

An old statute in England (Glaister) held that a child in utero was not a "reasonable creature in being and under the King's peace"; and with legal minutiae and acumen argued that it was a child in "posse" but not in "esse."

The Hebrews had a definite term for abortions—"neftel," i. e., a "dropping out" [3] but it is not mentioned in the Christian Bible in the Old or New Testaments. It is only when we consider the accessory books that mushroomed up around the sacred church literature in the early years of the Christian Era that any reference is found.

In the so-called Apocalypse of St. Peter which was discovered in upper Egypt in the latter half of the Nineteenth Century, we read: "And near that place Peter saw another strait place into which the gore and the filth of those who were being punished ran down and became there as it were a lake; and there sat women having the gore up to their necks, and over against them sat many children who were born to them out of due time crying; and there came forth from them sparks of fire and smote the women between the eyes; and these were the accursed who conceived and caused abortion . . ."

There have been scholars who have held to the opinion that the early Christian church developed its present conception of abortion from the contemporary Orphic sects and rituals that existed in the Greek peninsula and the archipelago. While this is perhaps true to a certain extent, it seems much more likely that it was because of the constantly increasing tendency toward celibacy and sexual asceticism on the part of the early Fathers.

Tertullian,[4] a vigorous-minded Christian who lived during the Second Century in North Africa writes in his Apologies: "Our religion on the contrary not only forbids murder but protects the fruit conceived in the womb while yet the tender elements are scarcely formed into a human being. To prevent birth is anticipated homicide; to take away life or to interrupt it in its natural course is equally culpable. That which is to be a man hath all the rights of humanity; the whole future fruit is concentrated in the seed. . . ."

(Incidentally this same writer also declared that a second marriage following the death of the first partner was frank adultery!)

In the second chapter of the extra-canonical document known as 'HΔIδσχη' i. e., "The Teaching of the Apostles" exists the following statement: "Thou shalt not slay a child by abortion nor that which is conceived shalt thou destroy . . ." Athenagoras, (A Plea for the Christians, circa 175 A. D.) allies it with murder.

Again in the Epistle of St. Barnabas (Chapter XIX) we read, "Thou shalt not destroy the conceptions before they are brought forth; nor kill them after they are born."

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[3] The word "abortion" as we use it is taken from the Latin "aboriri" meaning to perish.

[4] Tertullian was by no means original in his desire for celibacy in the clergy. He himself mentions the fact that it was one of the customs of the "heathen" priests in Egypt. (Ad Uxorem 1, 6)

Augustine (circa 400 A. D.) argued that the embryo might share in the resurrection while Fulgentius maintained that without baptism eternal punishment is the lot of the unborn. Gregory of Nyassa (circa 380 A. D.) was one of the first to advocate the view that 'life principle' or soul began in an embryo at the first moment of its existence. The Letters of Basil (325 A. D.) accuse the woman of wilful murder. "With us there is no nice enquiry as to its being formed or unformed. . ." The punishment . . . "should not be for life but for a term of ten years." Octavius Minucius Felix, (Chapter XXX) calls the deed an out and out parricide.

Rome at about the Fourth Century decreed exile against the mothers who had criminal abortions. Those who gave the drugs in order to procure them were punished according to their individual social status. If they were aristocrats and nobles they were only banished to various islands in the Mediterranean, but if they were of the laboring classes they were sent to work in the metal mines.

The Council of Eliberis (IV Century) ruled that the Holy Communion of the Christian Church should be refused to all such malefactors for the rest of their lives even on their death beds (Catholic Encyclopedia) and the Sixth Ecumenical Council (680 A. D.) decided that anyone who procured abortion should bear all punishment inflicted and created for murderers. Similar resolutions were passed at Ancyra (314 A. D.) and in the Quinisext Convention (692 A. D.) The Justinian Code made it a criminal offence (circa 500 A. D.).

The Visigoths prescribed death, or the privation of sight for the mother who allowed such procedures and to the father who consented to such measures.

The first recorded foundling hospital in Europe was established by Datheus in Milan in 789 A. D. in an attempt to provide a place for children conceived in adultery. These would not need to be damned eternally as he thought they would be were they torn from their mothers' wombs without baptism.

Rongy states that Saint Beda (VIIIth Century) considered poverty of the women to be a mitigating circumstance. The German Code of Church Laws in the Tenth Century held to the same idea. The Archbishop of Canterbury required a pilgrimage or one year of "penitential exercise" for women who aborted before the fortieth day. Pope Sixtus V in a bull of 1588 subjected those guilty of the crime to all civil and ecclesiastical penalties inflicted for murder. Gregory XIV also publicly forbade it three years later.

Lecky recounts a legend about a man who had always been desirous of knowing just how a child appeared in utero, and who had in an effort to satisfy this curiosity killed a pregnant woman. Remorse overcame him for this double murder. He fled to the desert where he prayed and fasted for years until finally a voice told him that God had forgiven him for the death of the parent. But to

the end of his days he never was able to obtain any assurance that he was absolved from the crime of the foetus, and at last died, still ignorant and still worried about his future salvation.

The Sixteenth Century found the Italian Cities of Milan and Genoa making the abortion of a "foetus animatus" a capital crime. In England, according to Sir Matthew Hale (1609-1676), it was not an offense, but Blackstone (1723-1780) was of the opinion that, "To kill a child in its mother's womb is now no murder but a great misprision; but if the child be born alive and dieth by reason of the potion or the bruises it received in the womb, it seems by the better opinion to be murder . . ."

In Burton's "Anatomy of Melancholy" (part 1, sec. 3, Subsec. 4) we read of the alleged abortions and infanticides in the nunneries of his time.

Fienus of Louvain, Belgium, in 1620 said that the human soul was created and placed into the embryo three days after conception. Thirty odd years later Florentius taught that the soul may be intellectual or human from the first moment and soon after this Zachias, the Pope's own private physician, was quite sure that it entered into the tissue at the beginning of life.

In France (1555) by royal edict which was renewed by Louis XIV (1708) capital punishment was inflicted for adultery and abortion combined.

Montesquieu, the famous XVIIIth Century French Jurist states that the Formosans of his time demanded that their priestesses produce abortions. "La religion ne permet pas aux femmes de mettre des enfans au monde qu'elles n'aient trente-cinq ans; avant cêt âge, la prêtresse leur foule le ventre et les fait avorter . . ."

Semitic: The Semites believed that an abortion, a cripple, or a malformed infant was the semi-human offspring of a devil.

The Talmud declared (Thompson) that the dwellings of heathen must be considered unclean because miscarriages are supposed to be buried therein. According to the legends of the later Jewish demonology, devils are not "fallen angels" but are really abortions or immature creatures.

Mohammed (died 632 A. D.) is said to have commanded that prayers be given for an "untimely birth," and ordered supplications for forgiveness and mercy to the parents.

The Arab's understanding of embryology as stated in the Koran was as follows:

"He formeth you in the wombs of your mothers by several gradual formations, within the three veils of darkness" (the abdomen, uterus and membranes?)

Directions are also given for sacrifices of the offspring of animals yet unborn.

Various writers and travelers of the East have mentioned this frequent practice among the Mohammedan countries.

The surgical and obstetrical textbooks of the Middle Ages and the succeeding centuries, to be sure, discuss the probable reasons for bleeding and best methods of treating abortion. Guy de Chauliac, Ambrose

Paré, Justine Siegemunden, Smellie, and Madame Boivin can be mentioned as only a few of a great many writers on the subject.

The primitive tribes of today have definite opinions on the subject. The South American Indians living in the Gran Chaco of Paraguay are said to advocate and practice it after two normal births. This is done in order to prevent the raising of a large family which they would not be able to support and which would interfere with their own food. Each woman suckles her child up to three years and her husband is forbidden to have intercourse with her. The result is that he marries some one else, and this is considered to be quite "proper." On the other hand in the Amazon River country abortions are done to prevent the pangs of child birth. The North American Indians with the exception of the Dakotas recognized this as a crime. In the South Seas artificial abortion was quite prevalent while the Esquimaux hold to the practice as a matter of economy.

The African tribes have various beliefs. One tribe (the Ba Pedi) believes that a woman who has had an abortion can kill a man merely by lying with him. Her victim becomes poisoned and the entire country may be affected. There may even be droughts. The blood from such a woman is taboo and should not be spilled on the ground. The woman is arrested and the spot where the foetus was buried located. From here a little earth is taken and sprinkled into the river. Water from it is taken and then sprayed onto the place where the blood has fallen in an effort to purify and absolve the deed. Then a ball of the mud containing the blood is rolled up and dropped into five different streams in all portions of the compass by five virgins. A tribe along the Limpopo River (Ba Tonga) have elaborate cleansing ceremonies for the women whenever there is a lack of rainfall that has been caused by the abortion of one of their number.

The Kafirs for their part fine the victim four or five head of cattle and consider the accomplices equally guilty.

Nowadays the existing laws and legislatures in the Occident, to quote Alexander Roubakine, "Seek to protect the future child, a being not yet existent, by severely punishing the woman who already exists and has been punished severely enough by nature already."

In an effort to counteract this in Soviet Russia in 1920 the following decree was published:

"During the last decade the number of women seeking to terminate pregnancy has increased both in the West and in our country. In the laws of all countries

this evil is combatted both by punishment for the woman who decides to take this step and for the doctor who performs the operation. Without achieving positive results this method of combatting it has driven the operation underground and has left women to be victims of mercenary and frequently ignorant abortionists who have worked up an underground profession for themselves. As a result up to 50 per cent of the women become ill through infection and up to four per cent of them die. The workers and peasants government realizes all the evil effect which this might have on the community. By the strengthening of the socialist system and by carrying on agitation against abortions among the masses of working women in the population, it combats this evil and, widely establishing the principle of the protection of motherhood and infancy, foresees the gradual disappearance of this phenomenon. But for the present the survivals of the morals of the past and the difficult economic conditions, force some women to have recourse to this operation. The Narkomzdrav and the Narkomyust, protecting the health of the women and the interests of the race from ignorant and mercenary plunderers, and considering methods of repression in this field absolutely futile, therefore decree:

"1. To permit the performance of the operation known as abortion free of charge, under Soviet hospital conditions, where a minimum of injury can be guaranteed.

"2. The performance of this operation is absolutely forbidden to anyone but licensed doctors.

"3. An accoucheur or mid-wife guilty of performing this operation is deprived of the right to practice and is turned over to the People's court.

"4. Doctors, carrying out this operation as part of their private practice, with mercenary aims, are also turned over to the court."

Article 140 of the Criminal Code of the R. S. F. S. R. provides the following penalty for performing abortions under illegal conditions.

"Anyone performing abortions, with the consent of the mother, but not having the necessary medical training, or anyone having the necessary training but performing the operation under unsanitary conditions is subject to deprivation of liberty or to forced labor for a period up to one year, or a fine up to 500 rubles.

"If the operation is performed under the conditions described above, with the aim of profit, without the consent of the mother, or resulting in the mother's death, the punishment is imprisonment for a period up to five years."

The labor code provides that women occupied in physical labor are to be freed from work for three weeks following abortions and women at desk jobs ("mental labor") for two weeks with no cessation or reduction in pay in either case.

FREQUENCY

"The fallaciousness of medical statistics in the settlement of questions of importance is seldom more marked than in abortions." H. B. Storer, Boston, 1863.

Hundreds of clinicians and statisticians have tried in one way or another to solve the question of the actual frequency of occurrence of abortion, and most of them freely confess their inability to arrive at anywhere near the actual number for any given locality or country. The shame taboo is too great and hides dozens of cases to every one that may be revealed. Accordingly, those authors who may write about a subject will bravely guess; others more shrewd will limit themselves and their discussions to known cases in hospitals or clinics and admit and recognize only too clearly the limitations of such methods.

Williams declares that every fifth or sixth pregnancy is a spontaneous abortion. Whitehead of Manchester (Penrose, 1877) maintained that there are 37 abortions out of every hundred pregnancies. Schumann (1924) declared that 80-90 per cent of all cases are induced. To quote Gelhorn (1928), in 1890 in Germany there was one abortion to ten births, but in 1911 there was one to five.

Whitehouse in 1928 maintained that the greatest number of abortions occurred in the most fertile. He reported 1000 cases of abortion from the Birmingham General Hospital (England) and found that these women had produced 3,228 children and in addition had had 597 abortions, and that among 3,000 hospital cases 35 per cent had had an abortion at some time in their lives. He declared that the pre-war and post-war ratios were the same.

Taussig (1910) gives figures which he gathered from various authors and sources. Michaeloff in 257,988 births in pre-war Russia found the proportion of full term deliveries to abortions was ten to one. Keyssner had a series of 469 abortions to 2,623 confinements and points out that hospital figures are always too low inasmuch as a great many more are taken care of at home. Taussig cites Treub who had 202 confessed abortions out of 1,924 actual cases and he estimated that there were then 80,000 criminal abortions yearly in New York City and from 6,000 to 10,000 annually in Chicago. Stabel believes that in New York nowadays there are at least 80,000 per annum, and Rongy estimates that there are now 1,250,000 abortions a year in the United States. Ehrenfest believed that fifty per cent of all abortions in this country are criminal in origin, that 37 per cent are spontaneous, and that thirteen per cent are therapeutic.

Roubakine says that in Germany in 1911 there were 240,000; 1923, 500,000; 1924, 875,750, and in 1927 over 1,000,000 abortions (Benthin, Heinemann, Lippmann); that in Germany in 1911 the proportion of abortions to live births was one to eight; and in 1923 it was one to two accouchements while in 1927 there were as many abortions as childbirths. In France before the War there were calculated to be 500,000 abortions annually (Lacassagne). In Poland abortions average 25 per cent of the total births. The same author points out the paltry number of convictions to the number of cases actually committed.

In Germany, Great Britain, Switzerland, and France, all attempts (and there have been many) to change the present conditions have been rejected. Esthonia and Russia are the only countries that openly

acknowledge and defend legalized abortions for other than the so-called therapeutic variety.

In Leningrad in 1928 the number of registered abortions is represented as 53,000 for 38,000 registered accouchements. In Moscow, 70 were registered for every 100 normal deliveries. (Roubakine)

PATHOLOGY

So much has been written elsewhere on the pathology, histology, and bacteriology of abortions and the whole question has been discussed so thoroughly that there appears to be no need for a detailed account in this paper. The reader is referred to standard textbooks on Gynaecology and Obstetrics for any information along these lines that he may desire.

DIFFERENTIAL DIAGNOSIS

A differential diagnosis must always be made from ectopic pregnancy, carcinomata, fibroids, (especially submucous,) hemorrhagic endometritis, and irregular menses.

SPONTANEOUS ABORTIONS

The physiological reasons for spontaneous abortions have been thoroughly discussed in other papers, and briefly stated the primary exciting factors are:

(1) Mechanical irritation
(2) Thermic irritation
(3) Toxic irritation
(4) Nerve irritation
(5) Death of the foetus
(6) Allergy or
(7) Endocrine Disorders

CRIMINAL ABORTIONS

"There is a fashion in this (i. e., abortions) as in all other female customs, good and bad." (Storer).

There have been hundreds of articles used and tried in the production of criminal abortion. The Esquimaux use seal ribs, the Brazilian natives pineapples, the modern British Indian nutmeg sticks. The natives of New Caledonia try green bananas; the Chinese, dried cow

lice. There is a certain tribe in Central Africa in the Congo Country who use ivory sticks. In the Torres Straits the pregnant mother is instructed to climb up and down a cocoanut tree, bumping her abdomen vigorously as she goes! The list could be prolonged indefinitely. The favorites in home remedies in the United States are slippery elm, and of late years a boiled rubber catheter. But hat pins, feathers, and wires are all used far too frequently. Occasionally they have broken off and must be gotten out by means of a laparotomy incision. The literature is full of reports of such cases. The use of gunpowder apparently had its origin in Hungary (Aptekar). The powder is dissolved in vinegar and swallowed, the patient believing that as "It drives out a bullet from a gun so will it drive out the foetus from the womb." With modern ideas of speed and added efficiency, T.N.T. has even been used, but only too frequently the patient is admitted with generalized nitrol poisoning.

The production of criminal abortion has been brought about by:

A. The use of drugs [5]
   1, locally on the cervix or vagina (as, for example with iodine)
   2, systematically which aims at
      a, contracting the uterus (ergot)
      b, irritating the mucous membrane of the gastro-enteric tract which reflexly acts on the uterus.
      c, irritants which attempt to act on the genito-urinary membranes.

B. Dilatation of the cervix
   1, entering or
   2, not entering into the uterine cavity by instruments of every known shape and variety, and employing medicine, liquid, and solid.

LUES

The present idea seems to be that very few if any abortions come from syphilis, and it is only after the fifth month that lues plays a rôle in the development of the child and will frequently cause miscarriage.

---

[5] The dangers of the use of proprietary medicines have been pointed out in an excellent article by Van de Warker in 1873.

THERAPY

After the abortion has taken place the treatment resolves itself into:

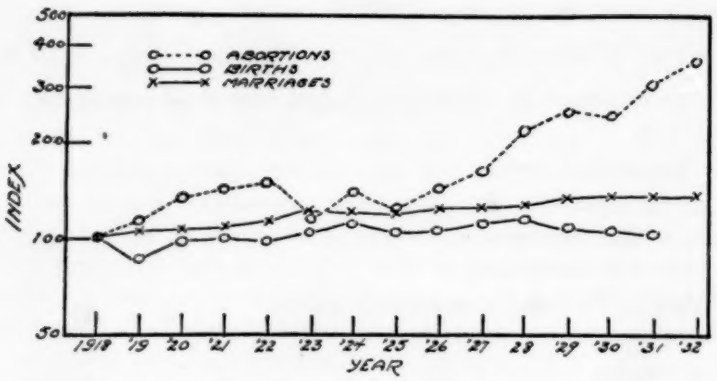
1. The expectant in which it is hoped that the bleeding will stop per se,
2. Cleaning the uterus,
   a, per digitem
   b, with a dull curette
   c, with a sharp curette
3. Packing or using a tamponade either,
   a, vaginal
   b, uterine
4. Hysterectomy (Advocated by some of the French Gynaecologists),
5. A combination of 2 and 3, or the so-called "cleaning and packing."

The amount of fever and the general degree of infection influences the treatment in most of the present day hospitals. For the last few years in the Cincinnati General Hospital no attempt was made to clean the uterus if the temperature was over 101° F. provided, of course, that the hemorrhage was not too profuse. The patient is placed in the Fowler's position, fluids forced, and infusions are given when necessary. Multiple small blood transfusions, about two to three hundred cc. have been advocated and given every two or three days until the temperature and general condition becomes improved. Our experience with antistreptococci sera has not been gratifying and confirms Novak's findings.

AN ANALYSIS OF 2,098 CASES OF ABORTIONS TREATED AT THE CINCINNATI GENERAL HOSPITAL 1918-32

Frequency

Table 1 shows a comparison of indices of abortions in the Cincinnati General Hospital, the birth population (Cincinnati) and the marriages registered in Hamilton County (Cincinnati). Graph A is an arithlog of these data. It is seen that while the last two rates are practically straight lines the abortion curve ascends quite highly in 1928, and has increased yearly from that time until in 1932 the index was 361.04.



GRAPH A. A COMPARISON OF INDICES OF ABORTIONS ON AN ARITHLOG GRID IN THE CINCINNATI GENERAL HOSPITAL, THE BIRTHS IN CINCINNATI, AND THE MARRIAGES IN HAMILTON COUNTY (CINCINNATI) 1918-32

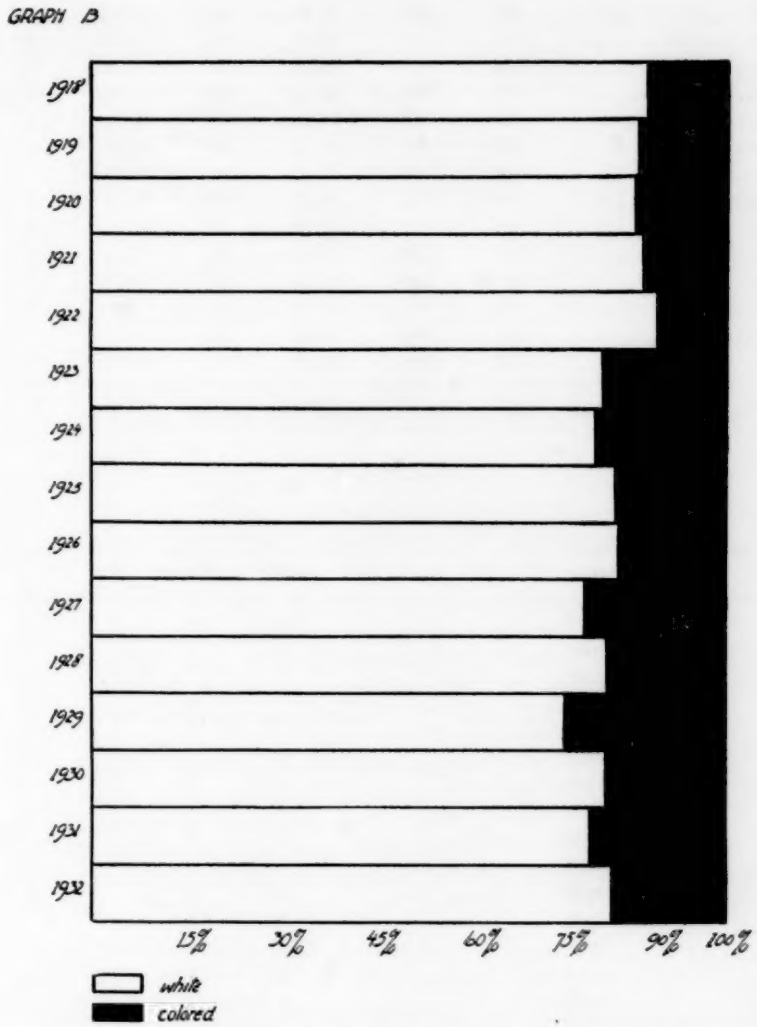
TABLE 1

A Comparison of Abortions in Cincinnati General Hospital, Marriages in Hamilton County (Cincinnati) and Birth Rate in Cincinnati

YEAR	ACTUAL CASES OF ABORTION	INDEX WHEN 77 : 100	ACTUAL NUMBER OF MARRIAGES	INDEX WHEN 287 : 100	TOTAL BORN (REGISTERED)	INDEX WHEN 7,930 : 100
1918.....	77	100	287	100	7,930	100
1919.....	86	111.68	303	105.57	6,943	87.55
1920.....	101	131.16	304	105.92	7,839	98.85
1921.....	109	141.55	314	109.40	8,152	102.79
1922.....	117	151.94	323	112.54	7,877	99.32
1923.....	88	114.28	330	114.98	8,356	105.37
1924.....	109	141.55	347	120.91	8,817	111.18
1925.....	97	125.97	347	120.91	8,381	105.68
1926.....	113	146.75	354	123.34	8,623	108.73
1927.....	131	170.13	362	126.13	8,816	111.17
1928.....	171	220.08	369	128.57	9,062	114.27
1929.....	197	255.84	376	131.01	8,845	111.53
1930.....	190	246.75	383	133.45	8,710	109.83
1931.....	234	303.89	389	135.54	8,261	104.17
1932.....	278	361.04	394	137.28	....	.....

Color

The total number of cases included in the Cincinnati General Hospital Series from 1918-32 were 2,098 of which 1,717 were white, 369 were colored, and 12 in which the race was not definitely stated. (Graph B). There were no great yearly differences.



GRAPH B. PERCENTAGE OF CASES OF ABORTION AS TO RACE BY YEARS

TABLE 2

Abortions in Cincinnati General Hospital by Color

YEAR	TOTAL	WHITE	PER CENT WHITE	COLORED	PER CENT COLORED	NOT STATED
1918	77	69	89.61	8	10.39	0
1919	86	75	87.20	11	12.79	0
1920	101	87	86.13	14	13.86	0
1921	109	97	88.99	12	11.00	0
1922	117	105	89.74	12	10.25	0
1923	88	68	80.95	16	19.05	4
1924	109	85	79.43	22	20.56	2
1925	97	80	82.47	17	17.52	0
1926	113	94	83.18	18	16.07	1
1927	131	102	77.86	28	21.54	1
1928	171	136	81.43	31	18.56	4
1929	197	146	74.11	51	25.89	0
1930	190	161	84.73	29	18.01	0
1931	234	183	78.20	51	21.79	0
1932	278	229	82.37	49	17.62	0
Total	2,098	1,717	81.84	369	17.59	12

TABLE 3

Mortality by Years

YEAR	WHITE	COLORED
1918	0	0
1919	2	0
1920	3	2
1921	1	1
1922	3	0
1923	0	0
1924	0	0
1925	0	0
1926	1	0
1927	0	0
1928	1	1
1929	0	0
1930	0	0
1931	0	0
1932	3	0
Total	14	4

Mortality

The mortality in the Cincinnati General Hospital series was 0.8 per cent (18 actual deaths in 2,098 cases). This is of interest in view of the recent Russian figures given at 0.7 per cent. (See Editorial in the *Journal American Medical Association* for February 4, 1932.)

Data: Eighteen actual cases died, of which 14 were white and 4 colored.

(a) *The ages of the 14 white women were as follows:*

18 years—2 cases	28 years—1 case
19 years—2 cases	31 years—1 case
22 years—1 case	33 years—1 case
23 years—1 case	37 years—2 cases
24 years—2 cases	38 years—1 case

(b) *The age of the 4 colored women:*

22 years—2 cases
28 years—1 case
Not stated—1 case

(c) *Deaths by months:*

January—4; February—1; March—0; April—1; May—1; June—1; July—0; August—2; September—2; October—2; November—2; and December—2.

(d) *Place of birth:*

There were 13 native born whites, and one foreigner (Hungarian). Ohio—5; Kentucky—5; Pennsylvania—2; Alabama—1; Illinois—1; New York—1; Tennessee—1; Utah—1; Hungary—1.

(e) *The Treatment given to the 18 cases was as follows:*

2 patients had only shock therapy
2 patients apparently had only bedrest and "forced fluids"
6 patients had intravenous therapy which also included blood transfusions and antistreptococci sera

Operations:

1 patient had D. & C. plus laparotomy
2 patients had cul-de-sac drainage
1 patient had uterus packed
3 patients had uterus cleaned and packed
1 patient had uterus cleaned and packed in addition to shock therapy

(f) *Hospital Days Before Death*

1 day or less than 1 day in hospital (two were less than 2 hours)..... 6 cases
2 days in hospital..... 2 cases
3 days in hospital..... 1 case
4 days in hospital..... 2 cases

5 days in hospital..... 1 case
7 days in hospital..... 2 cases
9 days in hospital..... 1 case
10 days in hospital..... 1 case
12 days in hospital..... 1 case
14 days in hospital..... 1 case

Frequency Distribution of Ages

Table 4 and Graph C give the cases in the Cincinnati General Hospital group in five-year age periods. Calculated from a biometrical standpoint the following data obtain:

Grand total — 2,090 with Recorded ages[6]
Mean age = 26.65
Standard deviation (σ) = 6.692755
Probable error mean (P. E. mean) = ± .0987406
Grand total white (1,715 recorded ages)
Mean = 26.8
Standard deviation (σ) = 6.6451710
Probable error mean (P. E. mean) = .10823
Grand total colored (368 recorded ages)
Mean = 25.46
Standard deviation (σ) = 6.740830
Probable error mean (P. E. mean) = .2370

Tables 5-7 give the details of the three classifications with reference to admission rate per year between 1918-32.

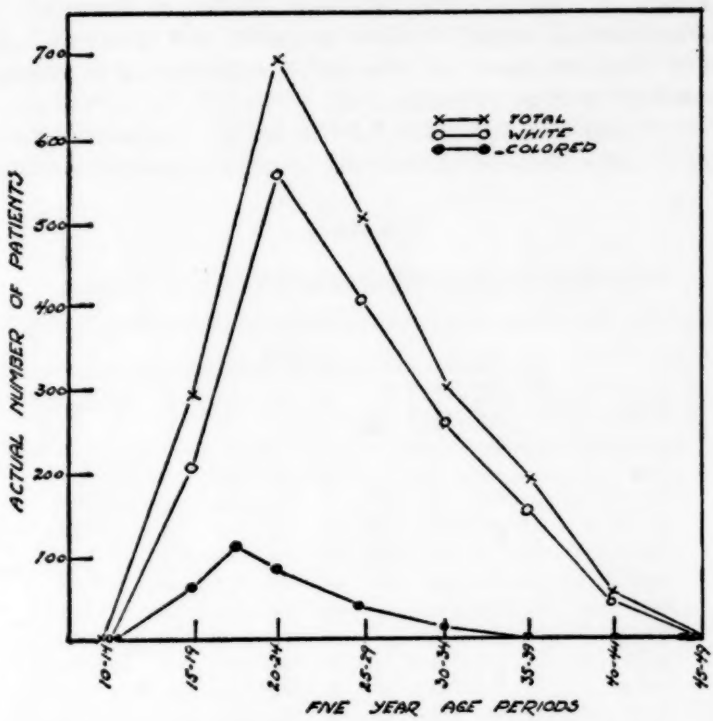
Therapy

The total number of cases studied were 2,098 and they spent a grand total of 18,899 days in the Hospital wards. The average stay of each patient was nine days.

The patients leaving the hospital before the doctors had been willing to discharge them have been included in the above. If these few had not been added the days would have been placed at a slightly higher total. But it will be recognized that this is a constant error to all intents and purposes for all the methods of treatment.

The series of 274 cases treated by dilatation and curettage include those cases which were anaesthetized and operated upon in the Opera-

[6] Eight cases did not have any recorded age.



GRAPH C. CASES OF ABORTION GROUPED IN FIVE YEAR AGE PERIODS ACCORDING TO RACE

TABLE 4

Frequency Distribution in Five Year Groupings

	AGE										
	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	Not Stated
2098	5	299	692	505	315	197	69	7	0	1	8
White, 1717	2	221	567	423	270	163	63	6	0	0	2
Colored, 369	3	76	124	82	42	34	5	1	1	0	1
Not stated, 12	0	2	1	0	3	0	1	0	0	0	5

ting Room. A large proportion had been bleeding at home for a few weeks and perhaps would represent a considerable percentage of the so-called "obstinate cases" or those which would refuse to respond to home therapy or to no treatment at all.

Table 9 and Graph D show the relation of primipara to the total number of cases admitted as abortions to the Cincinnati General Hos-

TABLE 5

Total White Frequency Distribution in Five Year Groupings

YEAR	AGE								
	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	Not Stated
1918	0	5	25	8	13	17	1	0	0
1919	0	10	18	21	12	11	3	0	0
1920	0	10	24	21	19	9	4	0	0
1921	0	16	27	25	16	10	3	0	0
1922	0	20	37	25	10	10	2	0	1
1923	0	7	20	19	14	4	4	0	0
1924	0	14	34	16	12	4	5	0	0
1925	0	12	23	16	20	4	5	0	0
1926	0	15	36	16	19	4	2	2	0
1927	0	16	34	19	13	13	6	1	0
1928	0	11	66	28	15	13	3	0	0
1929	0	16	49	41	20	14	5	1	0
1930	1	19	56	43	21	18	2	0	1
1931	0	16	53	67	26	11	8	2	0
1932	1	34	65	58	40	21	10	0	0
Total, 1717	2	221	567	423	270	163	63	6	2

pital. The list of "probable primipara" has been omitted. This "probable list" contains those who from their age or suggestive history were apparently pregnant for the first time. But as these data were not definitely stated anywhere in the history, they cannot be fairly included. The relation of the primipara compared to all cases of abortion has been plotted on an arithilog grid, and one finds that the curves are essentially parallel.

The Hospital cost can be figured easily with the above data. In the years 1918-32 the average cost of a patient in the wards of the General

Hospital was $2.97; therefore, the total maintenance cost for the 2,098 cases that average nine days' care was $56,079.54. This does not allow for depreciation and includes only the items of food and linen plus nursing service. Let us consider the professional services rendered. The average price of a so-called minor operation is rated at, say, $25.00, which in these cases would be ridiculously low as the anaesthetist, the

TABLE 6

Total Colored Frequency Distribution in Five Year Groupings

YEAR	AGE									
	10-14	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	Not Stated
1918	0	2	2	2	1	1	0	0	0	0
1919	0	2	3	3	1	1	1	0	0	0
1920	0	3	5	4	0	2	0	0	0	0
1921	0	2	7	2	0	1	0	0	0	0
1922	0	2	4	3	2	0	1	0	0	0
1923	0	3	6	4	1	2	0	0	0	0
1924	0	6	7	4	4	1	0	0	0	0
1925	0	4	5	3	3	2	0	0	0	0
1926	0	3	7	4	2	2	0	0	0	0
1927	0	5	8	3	5	7	0	0	0	0
1928	0	2	11	11	6	0	1	0	0	0
1929	0	18	18	8	4	1	1	0	1	0
1930	0	7	7	7	2	3	1	1	0	1
1931	0	8	20	11	6	6	0	0	0	0
1932	3	9	14	13	5	5	0	0	0	0
Total, 369	3	76	124	82	42	34	5	1	1	1

operating room fees, and the laboratory work are not included. But this would amount to $52,450. All in all it can be safely said the cost of these cases has been at least $108,000 or $6,000 per annum.

Below is a list of the complications which were coexistent or present while the patient was in the Hospital. It does not necessarily follow that *all* were included. Far too often the notes were scanty and insufficient. For illustration, let us take the cases listed as "secondary anaemia" which are given as twenty-four. The definition of "secondary anaemia" to interns is a broad one. In many cases there was no haemo-

TABLE 7

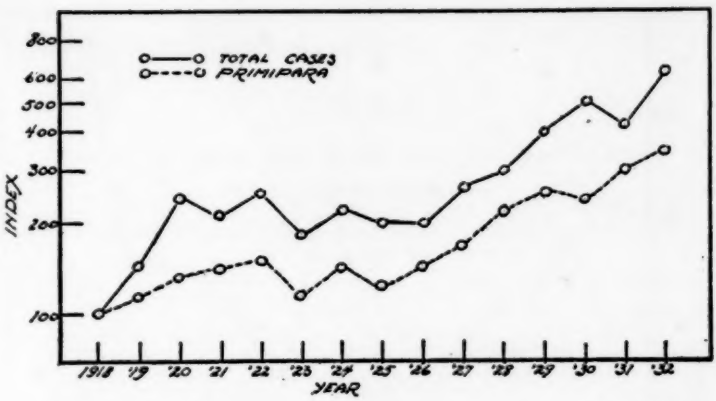
Frequency Distribution of Cases Not Stated as to Race in Five Year Groupings

YEAR	AGE							
	10-14	15-19	20-24	25-29	30-34	35-39	40-44	Not Stated
1918	0	0	0	0	0	0	0	0
1919	0	0	0	0	0	0	0	0
1920	0	0	0	0	0	0	0	0
1921	0	0	0	0	0	0	0	0
1922	0	0	0	0	0	0	0	0
1923	0	2	0	0	1	0	1	0
1924	0	0	1	0	0	0	0	0
1925	0	0	0	0	0	0	0	1
1926	0	0	0	0	0	0	0	1
1927	0	0	0	0	0	0	0	1
1928	0	0	0	0	2	0	0	2
1929	0	0	0	0	0	0	0	0
1930	0	0	0	0	0	0	0	0
1931	0	0	0	0	0	0	0	0
1932	0	0	0	0	0	0	0	0
Total, 12	0	2	1	0	3	0	1	5

TABLE 8

Therapy

	CASES	TOTAL DAYS	AVERAGE PATIENT DAYS
(1) Cleaned only	167	1,336	8
(2) Cleaned and packed	838	6,843	8
(3) Bed rest and supportive measures	604	5,111	8
(4) Clean and pack plus dilatation and curettage	111	1,140	10
(5) Packed only	61	703	11
(6) Dilatation and curettage	274	3,040	11
(7) Miscellaneous Operations: laparotomies; tampons; cul-de-sac drainages	41	701	17
(8) Not stated	2	25	12

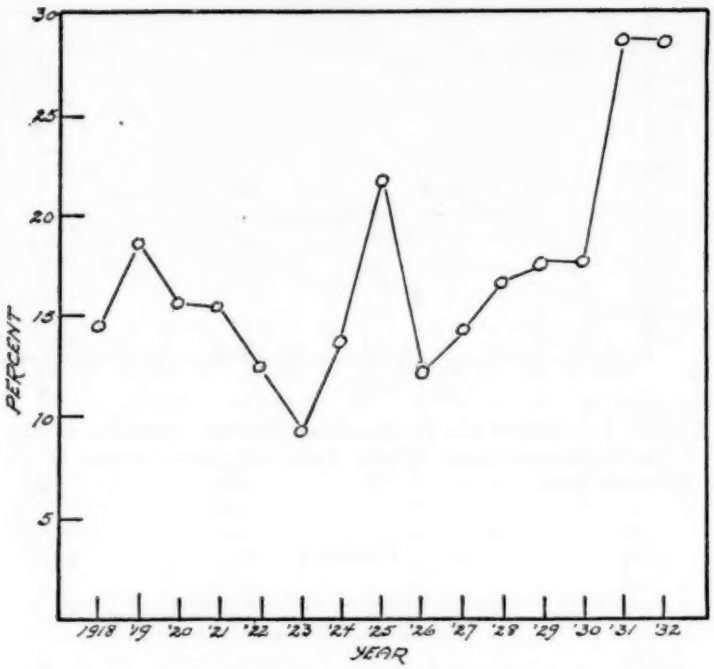


GRAPH D. COMPARISON OF PRIMIPARA HAVING ABORTIONS TO THE TOTAL NUMBER OF CASES HAVING ABORTIONS USING INDICES ON AN ARITHLOG BASIS

TABLE 9

Showing Relation of Primipara to Total Number of Cases Admitted as Abortions

YEAR	ACTUAL NUMBER CASES	PRIMI-PARA	PROBABLE PRIMI-PARA	NOT STATED	INDEX PRIMIPARA WHEN 7 : 100
Total	2098	305	74	202	
1918	77	7	2	13	100
1919	86	10	3	11	142.8
1920	101	17	8	1	242.8
1921	109	15	15	1	214.2
1922	117	18	4	6	257.1
1923	88	13	2	5	185.7
1924	109	16	7	16	228.5
1925	97	14	5	10	200.0
1926	113	14	6	6	200.0
1927	131	19	1	21	271.4
1928	171	21	4	20	300.0
1929	197	29	4	20	414.2
1930	190	36	0	19	514.2
1931	234	30	4	32	428.5
1932	278	46	9	21	657.1



GRAPH E. GRAPH SHOWING PERCENTAGE OF CASES ADMITTED WITH A HISTORY OF CHILLS

TABLE 10

Complications Coexistent or Present While in Hospital of the Abortions in 1918-32

Salpingitis and endometritis.....	43	Recognized perforated uterus...	3
Secondary anaemia mentioned...	24	Rectal	3
Cul-de-sac abscess	10	Asthma	1
Sore throat, tonsillitis.....	10	Lichen planus	1
Arthritis	9	Luminal rash	1
Cardiac	9	Malaria	1
Neurological or psychic.....	9	Mastitis	1
Definite pneumonia or pleurisy..	8	Measles	1
Abscesses (other than pelvic)...	6	Pulmonary tuberculosis	1
Pyelitis or cystitis	6	"Sacroiliac"	1
Thyroid	6	Scabies	2
Positive G. O.	3		

globin or red blood count noted, and the statement was merely made that the patient looked "markedly anaemic."

TABLE 11

Number of Patients Who Stated That Chills Had Occurred Before Hospital Admission

YEAR	TOTAL NO. OF CASES OF ABORTIONS	ACTUAL NO. CASES WITH CHILLS	PER CENT
Totals	2098	400	19.06
1918	77	11	14.2
1919	86	16	18.6
1920	101	16	15.8
1921	109	17	15.5
1922	117	15	12.8
1923	88	8	9.1
1924	109	15	13.7
1925	97	21	21.7
1926	113	14	12.3
1927	131	19	14.5
1928	171	29	16.9
1929	197	35	17.7
1930	190	34	17.8
1931	234	69	29.4
1932	278	81	29.1

Relation of Pregnancies to Abortions

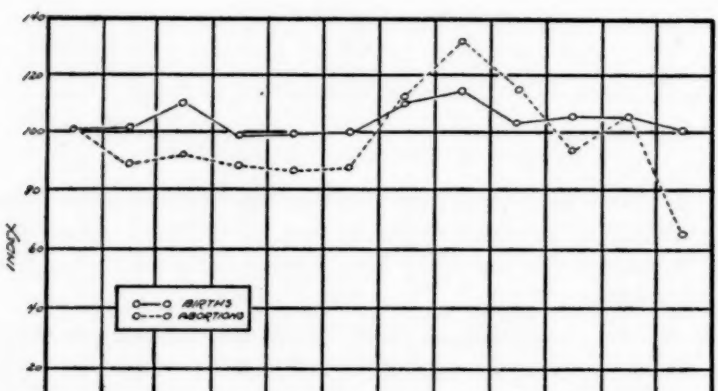
It has always been recognized that there has been a definite relation of the number of abortions to the number of full-term deliveries, but to our knowledge this has never been worked out mathematically on a correlation basis.

There were 3,339 abortions which include the past and present cases in our series. Solving the correlation between the patients' number of full term deliveries compared with the number of abortions of those same patients (vide Table 12) the following figure was found: $r = +.100814 \pm .011554$. This is obviously of statistical significance.

It is seen that the greatest number of cases occurs in August (216). This is curious in view of the generally accepted fact that the greatest

TABLE 12

NUMBER OF ABORTIONS	NUMBER OF FULL TERM DELIVERIES															
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	f
1	305	522	372	246	152	96	66	50	20	14	14	2	6	6	2	1873
2	140	178	162	132	82	42	34	20	12	12	4	2	0	0	0	820
3	58	62	78	32	28	26	8	18	12	6	2	0	0	0	0	330
4	12	30	32	28	16	12	6	6	2	2	0	0	0	0	0	146
5	6	10	22	14	4	8	8	4	0	0	2	0	0	0	2	80
6	2	10	12	2	2	0	4	0	0	4	0	0	0	0	0	36
7	2	4	4	4	2	0	0	0	4	0	0	0	0	0	0	20
8	0	0	6	4	0	0	2	0	0	2	0	0	0	0	0	14
9	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	2
10	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	4
11	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0	4
12	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	2
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	4
15	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	2
16	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2
f	525	818	688	468	296	184	128	98	52	40	22	4	6	6	4	3339



GRAPH F. INDICES SHOWING A COMPARISON OF CASES OF ABORTION IN THE CINCINNATI GENERAL HOSPITAL AND BIRTHS IN CINCINNATI PER MONTH (FOUR YEAR AVERAGE)

birth rate is also in August. This last statement is borne out in Graph F where the number of abortions occurring in the General Hospital is compared with the birth rate of Cincinnati for four years.

TABLE 13

Abortions by Months

1918 to 1932—2098 Cases

January	184	May	147	September	183
February	162	June	161	October	183
March	177	July	205	November	175
April	176	August	216	December	129

Comparison of Births and Abortions by Months

Table 14 and Graph F show the births and abortions for four years averaged and reduced to an index basis. At the Bureau of Vital Statistics of Cincinnati the births by months have not been kept officially, and it was through the courtesy of Mr. Evans of the Depart-

TABLE 14

A Comparison of the Births in Cincinnati and the Abortions at the Cincinnati General Hospital for the Years 1928, 1929, 1930, and 1932

MONTHS	AVERAGE 4 YEARS BIRTHS	WHEN 716.2 : 100 THEN	AVERAGE 4 YEARS ABORTIONS	WHEN 18 : 100 THEN
January	716.2	100	18	100
February	727	101.5	16	88.8
March	781.2	109.07	16.5	91.6
April	702.7	98.11	15.7	87.2
May	711.5	99.34	15.5	86.1
June	529.5	73.9	15.7	87.2
July	787.7	109.9	20	111.1
August	809.7	113.05	23.5	130.5
September	738.5	103.1	20.5	113.8
October	752.5	105.06	16.7	92.7
November	752.5	105.06	19	105.5
December	721	100.6	11.7	65.0

TABLE 15

Place of Birth

Total	2,098	
U. S. A.	1,964	(94.8%)
Foreign	108	(5.2%)
Not Stated	26	
U. S. A.		
Ohio	736	
Kentucky	603	
Tennessee	102	
Indiana	79	
Alabama	67	
Others (27 States)	511	

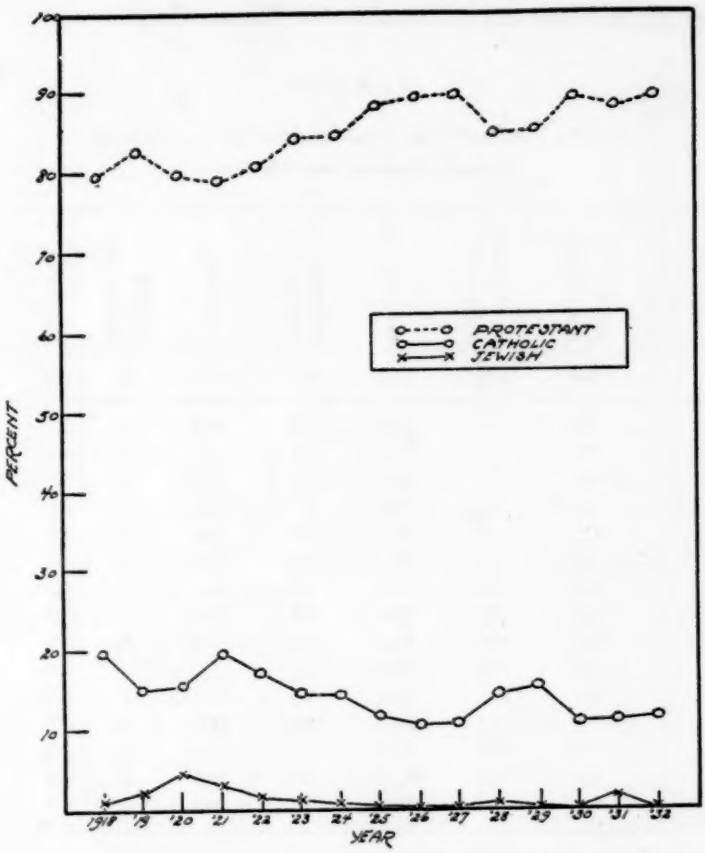
ment that the figures for 1928-29-30 and 1932 were obtained. These, he pointed out, are not entirely accurate as a certain proportion are carried over from one month to another, and the exact date of certain others cannot be gotten. The reader will, of course, see that there is a difference between the *time* of recording and the actual date of delivery. There would, however, tend to be a constant error throughout. It will be seen that the rise is pronounced in the summer months, especially

TABLE 16

Foreign Born

	ACTUAL NUMBER IN CINCINNATI GENERAL HOSPITAL SERIES	NUMBER IN CINCINNATI 1930 U. S. A. CENSUS	APPROXIMATE NUMBER PER 1,000
Germany	28	13,944	2
Italy	14	3,015	4
Great Britain and North Ireland	11	2,101	5
Russia	11	3,896	2
Hungary	10	....	..
Canada	8	773	10
Ireland	3	2,054	1
Poland	3	955	3
Others	12	....	..

in August. The lack of abortions in December could be explained by the Christmas Holidays as the average patient will be inclined to postpone any uterine therapy at this time of year.



GRAPH G. RELIGIOUS AFFILIATIONS OF PATIENTS ADMITTED TO THE CINCINNATI GENERAL HOSPITAL BECAUSE OF ABORTIONS

Religious Beliefs of Patients

There has been considerable comment recently in the birth control clinics in various parts of the United States about the alleged patronage of them by Roman Catholics. So great has this been that Latz has recently written a book approved by the Church of Rome for home

consumption. It is frankly stated that the purpose of the book is to combat this alleged present day tendency. In it the prevailing idea of the fertility rhythm curve and its obvious application to the marriage rites have been strongly stressed. The statement is often made that the number of abortions has increased in the Roman Church.

TABLE 17

Religious Affiliation of Patients Admitted to Cincinnati General Hospital for Abortions

YEAR	TOTAL ACTUAL NO.	PROTESTANT ACTUAL NO.	PER CENT	CATHOLIC ACTUAL NO.	PER CENT	JEWISH ACTUAL NO.	PER CENT	NOT STATED
Totals	2098	1785	85.1	283	13.5	19	0.9	11
1918	77	61	79.2	15	19.4	1	1	0
1919	86	71	82.5	13	15.1	2	2.3	0
1920	101	80	79.	16	15.8	5	4.95	0
1921	109	85	77.9	21	19.2	3	2.7	0
1922	117	95	81.	20	17.1	2	1.7	0
1923	88	74	84.	13	14.7	1	1.1	0
1924	109	90	84.1	16	14.9	1	0.93	2
1925	97	85	87.6	12	12.3	0	0	0
1926	113	100	88.4	13	11.5	0	0	0
1927	131	116	88.5	15	11.4	0	0	0
1928	171	146	85.3	24	14.1	1	0.58	0
1929	197	164	84.9	29	15.0	0	0	4
1930	190	168	88.4	22	11.5	0	0	0
1931	234	204	87.9	25	10.7	3	1.2	2
1932	278	246	89.4	29	10.5	0	0	3

In our series there were 1,785 Protestants, 283 Catholics, 19 Jewish and 11 not stated. Reduced to a yearly proportion (Graph G) it will be seen that the Catholic trend is slightly lower while that of the Protestant faith is slightly on the increase.

Table 18 is self-explanatory. Thirty-one per cent is low as the average patient at first will tend to deny manipulation. That it should vary from year to year (Graph H) is in part due to the individual house officers who obtained the histories. Some will insist on a truthful

TABLE 18

Patients Who Admitted Manipulative Procedures

YEAR	1918-32 ACTUAL CASES	ACTUAL NUMBER ADMITTING INDUCTION	PERCENTAGE
Total	2098	640	31
1918	77	27	35.0
1919	86	29	33.7
1920	101	25	24.7
1921	109	42	38.5
1922	117	44	37.6
1923	88	25	28.4
1924	109	35	32.1
1925	97	34	35.0
1926	113	35	30.9
1927	131	27	20.6
1928	171	42	24.6
1929	197	60	30.4
1930	190	69	36.3
1931	234	74	31.6
1932	278	72	25.8

answer; others will treat the matter as of little importance if no dangerous complications are present.

SUMMARY

(1) The social, ethical, and religious views for human abortions are discussed and presented.

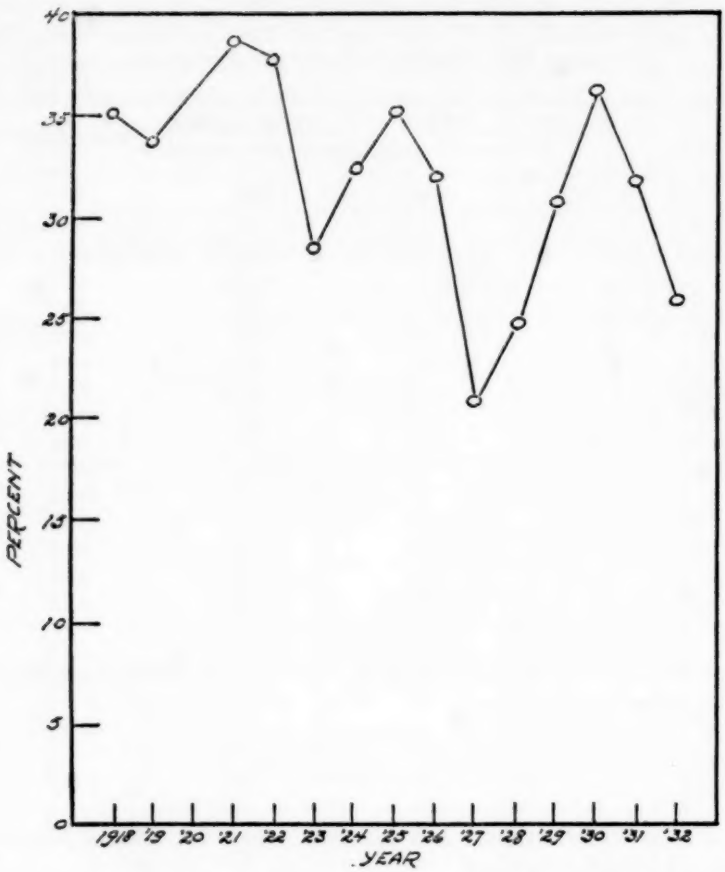
(2) A statistical study of 2,098 cases of abortion admitted to the Cincinnati General Hospital in 1918—32 has been made and subjected to analysis.

It has been found that:

(a) Tabulated indices of the abortions compared to the local marriage and birth rates show a tremendous annual increase of the first over the last two groups.

(b) There was no percentage increase of either the white or colored races in a period of 15 years (1918-32).

(c) The mean age of 2,090 recorded cases was 26.65 years; σ 6.692755; and P. E. mean $\pm$ .0987406.



GRAPH H. PERCENTAGE OF TOTAL CASES WITH ABORTION AT THE CINCINNATI GENERAL HOSPITAL WHO ADMITTED CRIMINAL INDUCTION (1918-32)

(d) The actual mortality was 0.8 per cent (18 cases).

(e) When the treatment was considered from a standpoint of days in the Hospital, bed rest without operative therapy was found to be essentially as efficacious as the more radical measures (8 days).

(f) The total expense is discussed and was conservatively estimated to be at least $108,000.

(g) The data would seem to show that there is a slight recent percentage increase in the patients professing the Protestant faith and a

diminution in the number of Catholics though these differences are not of statistical significance.

(h) Thirty-one per cent of the total number of cases admitted that their abortion had been criminally induced.

(i) The correlation of abortions to full term pregnancies was found:

$$r = +.100814 \pm .011554.$$

(j) The abortion rate is greatest in August and in this is essentially similar to the yearly birth curve.

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CRANIAL RELATIONSHIPS AND CORRELATION

BY RUTH SAWTELL WALLIS

Hamline University, St. Paul

THE existence of a force that shapes skull and face in harmony has been assiduously sought. In recent years the anthropologist's X-ray has been most frequently the coefficient of correlation. However blunt and insensitive the instrument may be, however distorted may be the resulting image of cranial interrelationships, there is value in assembling the evidences of interdependence within the terms of the technique. We may or may not have found the degree of biologically determined dependence between skull and face and jaw; we have measured their mathematical dependence and this we can follow through, watching the trends in size of coefficients as the parts correlated are adjacent or more distant, the possible effect of sex and of morphological type, the degree of consistency with which the same traits give the same results in several human groups.

Available studies have employed cranial correlations to a varied extent. The greatest number contain a few *r*'s for a few groups, too often composed of a few individuals. Others undertaken to solve some special problem of heredity, or form and function are restricted to three or four selected traits. Attempts to correlate everything with everything else have broken down at different distances from the goal through weariness and insolvency. The present study, an adjunct to extensive researches in race difference during the Merovingian period,[1] essays an orderly task within workable limits. Traits were selected for correlation that might reasonably be expected to bear some interrelationship; therefore, most of them, to use Pearson's term and concept, "cover" one another. But mutually inclusive measurements leading to spurious results were debarred. Four transverse diameters of head and face and three vertical diameters were selected for intercorrelations of breadths with

[1] The Committee on Grants in Aid of the National Research Council has made possible this analysis. The statistical work was done by W. Allen Wallis whose reliability and ingenuity greatly furthered the study.

breadths and heights with heights. The purpose was to ascertain the effect of degree of proximity on size of coefficient, and possible variations attributable to sex or type. Growing out of questions raised by these relationships, an investigation was made of the influence of total cranial length on these breadths and heights. Correlations of certain cranial and facial indices have been presented in an earlier paper (14).

The data employed are of three kinds: First, a series of Merovingian crania, all measurements of which were made by the writer and statistically analyzed under her direction.[2] Second, a European series of contrasting type, the crania from Greifenberg in Carinthia studied by H. L. Shapiro (12). Since the individual records are published, it was possible for us to work correlations for comparison with the main series. Third, scattered coefficients of European crania published by Scheidt (11) and Macdonell (6) (7), and three large series of non-European origin which contain many correlations of traits selected in the main group. These are Hooton's male series from Tenerife (1) and from the Pecos pueblo (2), and the Egyptian material of the XXVI-XXX Dynasties extensively studied by Pearson and Davin (10).

The nucleus of the research consists of crania of the Merovingian period from France, predominantly from the departments surrounding Paris, and from Southern Germany (Bavarian Reihengräber). The designation Merovingian includes crania of the fifth to the ninth century and in addition for the purposes of this paper, skulls labelled "Gallo-Romain" by Paris museums since no clear archaeological evidence marks off the graves of this preceding period. Moreover, no racial line distinguishes the crania. Expressed statistically, the difference divided by the standard error of the difference of means for 24 measurements of Gallo-Roman males compared with Merovingian is 1.22; for the 24 measurements of females, 1.14. The differences of the means of seven indices of males had an average of 1.18; of females, 1.25. Only one trait, head length of females, gave a significant difference of 3. The Reihengräber crania from Bavaria are also closely related to the Merovingian

[2] Through the generosity of Radcliffe College and of the late Mrs. William G. Farlow, the writer made a study of 500 crania in laboratories of the Muséum d'Histoire Naturelle and the École d'Anthropologie of Paris and the Anthropologisches Institut of the University of Munich. Great kindness and courtesy were extended by Professor Verneau, the late Professor Manouvrier and M. Paul Clavelin of Paris, and by the late Professor Rudolf Martin, and Dr. Walter Scheidt now of Hamburg.

series from France. For the same measurements and indices as the Gallo-Romans, the standard errors of Reihengräber difference from Merovingian are male 1.58 and 2.39; female 1.14 and 1.04. Therefore, for purposes of correlation, the three groups were combined.

A total of 281 male and 153 female skulls were measured by the writer; of these, 162 males and 118 females were the maxima qualifying for correlation. Where conspicuously smaller numbers occur, the records are limited to the French group labelled by museums "Mérovingien."

The combined series of Merovingian crania are predominantly of medium to long head form; only 20 per cent are brachycephalic. They are orthocephalic, metriocephalic, mesene, leptorhine. In contrast, the Central European group from Greifenberg is overwhelmingly brachycephalic, 69 per cent falling within that category; only 7 per cent are dolichocephalic. The Greifenberg crania are orthocephalic, tapeinocephalic, mesene, and mesorhine. The greatest contrasts in mean proportions then lie in the cephalic, height-breadth, and nasal indices. In terms of the standard error, the differences of the means of diameters and indices from those of the Merovingians proper are highly significant, a marked contrast to those of Merovingian and Gallo-Roman. The mean D/σ_D of 7 indices is 4.85 for males and 4.74 for females. The differences between the length, breadth and height of Greifenberg and Merovingian male crania are 8.72, 4.36, and 3.47 millimeters and the D/σ_D are 12.11, 7.15, and 5.37.

All anthropometric measurements conform to the International Agreement as set forth by Hrdlička and Martin (3) (8). The decision concerning sex of skulls, always too subjective a matter, was made by the writer alone, except for two samples checked by the late Professor Manouvrier in Paris and by Dr. Walter Scheidt at Munich. The coefficients of correlation, the Pearsonian r's, were calculated by the cross-product method, $r = \frac{\Sigma x y}{\sigma_x \sigma_y}$

CORRELATIONS OF TRANSVERSE DIAMETERS

The selection and segregation of transverse and of vertical diameters for systematic correlation was made with the purpose of obtaining a mathematical expression of cranial harmony.

The four transverse diameters giving the first six coefficients on Table 1 are the maximum breadth of the skull, the minimum frontal

diameter, the face breadth (bizygomatic) and the mandibular width (bigonial). From the strictly Merovingian series, there was selected every male skull (72) and every female (34) on which it was possible to measure all four breadths and all three heights. Therefore, the first six correlations on Table 1 and the first correlation of Table 3 were made from the same cases. In the last two correlations of Table 1, this strict comparability was abandoned in favor of the greatest number of cases secured by the inclusion of data from partially damaged crania. The six correlations computed from Merovingian male crania give little

TABLE 1

Correlation of Cranial and Facial Breadths—Merovingians

TRAIT	N	r MALE	N	r FEMALE
Cranial-Frontal	72	+.344	34	+.261
Cranial-Bizygomatic	72	.535	34	.478
Cranial-Bigonial	72	.297	34	.264
Frontal-Bizygomatic	72	.339	34	.190
Frontal-Bigonial	72	.211	34	.139
Bizygomatic-Bigonial	72	.532	34	.369
Bizygomatic-Orbital	162	.197	..	...
Bizygomatic-Nasal	162	.034	..	...

evidence of close interdependence. All are positive but the range is from the marked association of .5 to the doubtful significance of .2. Since the sample is not large, the rank rather than the exact size may be more significant. Adjacent diameters show on the whole the higher relationships, but the minimum frontal diameter is an exception. The highest correlations are between the proximate mandible and face breadths, and between face breadth and skull breadth. Face and skull breadth correlated with the minimum frontal diameter give smaller values. Also, for the most distant traits and lower coefficients, that of mandible and skull breadth is higher than mandible and the nearer frontal diameter. Averaged coefficients of each of the four breadths with the three other traits are: bizygomatic .47, cranial .39, bigonial .35, minimum frontal .30.

In all points, the Merovingian female series duplicates the male. The coefficients, though smaller, follow the same rank, and the averaged

r's of each trait with the other three also conform to the male order: bizygomatic .35, cranial .33, bigonial .29, minimum frontal .20.

The number of correlations with the bizygomatic breadth of the face as one variable was increased by calculating the coefficients of this diameter with nasal and with orbital breadth. The *r*'s using these two diameters apparently not structurally dependent on the size of the face bore out the expectation. Orbital breadth showed a very slight degree of association, nasal breadth none. (Table 1). The Merovingian male records alone were used. From the only comparative figures available, 103 Pecos Indians (Hooton (2)), the nose-face relationship was also the lower but both coefficients exceeded the Merovingian: nasal-facial, Merovingian .03, Pecos .10; orbital-facial, Merovingian .20, Pecos .60. The bizygomatic breadth of the Merovingian males, the diameter on the average most highly correlated with other transverse measurements of the face, enters into relationships varying from five to zero. The rank and size of coefficients are: with cranial breadth .54, bigonial .53, minimum frontal .34, orbital .20, nasal .03.

The comparative study of these transverse relationships in other groups of crania was limited by the absence of mandibles from many series and the omission in other cases of mandibular measurements from the correlations. With bigonial diameter dropped out and orbital and nasal breadths correlated with a transverse diameter only in the Pecos series, we have remaining the interrelationships of three breadths—skull, forehead, face—to compare in various groups.

Correlation size and relative position in the Greifenberg data show no differences in a group of distinct type. These almost uniformly brachycephalic crania with a mean maximum width that exceeds the Merovingian by 4.36 mm., have an average bizygomatic breadth greater by 1.28 mm. and a minimum frontal diameter only 0.6 mm. larger. None of this appears to affect the *r*'s. (Tables 2 and 8). Cranial and bizygomatic ranks first with +.60; cranial breadth and minimum frontal, minimum frontal and bizygomatic both register +.45. The Merovingian males, with fewer cases and smaller *r*'s, are the same in order and in the interval between the higher and lower coefficients (+.53, +.34, +.34). Correlations of Greifenberg female records were omitted because of expense.

Less perfect agreement is accorded by five other series. (Table 2). Of weighted means of the correlations, including the Greifenberg, minimum frontal diameter-bizygomatic breadth shows the lowest average

coefficient (.36) and ranks third in five out of six groups but cranial breadth-minimum frontal equals cranial breadth-bizygomatic (+.44 and +.42).

For setting the range and most probable values for two of these correlations, additional cases have been found in various publications (4) (11) (13). The relationship between skull and face breadth in twelve groups ranges from +.60 to +.26, most of the cases being near the upper limit. Of four at +.60, three are from Danish and Norwegian material (Scheidt); the lowest is from a group of Russian

TABLE 2

Correlation of Cranial and Facial Breadths—Comparative Groups

GROUP		CRANIAL AND FRONTAL	CRANIAL AND BIZYGOMATIC	FRONTAL AND BIZYGOMATIC
219 Greifenberg	M	+.461	+.603	+.456
127 Whitechapel ...	M	.432	.468 (43)	.620 (43 cases)
137 Whitechapel ...	F	.367	.414 (32)	.497 (32 cases)
245 Tenerife	M	.459	.516	.441
(800) Egyptians ...	M	.330	.373	.417
(400) Egyptians ...	F	.294	.337	.489
Weighted mean		=+.361	=+.422	=+.439

crania cited by Tscherpoursky. The unweighted average of the twelve *r*'s is +.49. Skull width and minimum frontal diameter in eleven groups spreads out more evenly from +.55 to +.26. The two highest coefficients are for non-European crania measured and correlated by Knowles, West African +.55, Eskimo +.52; the lowest are for the Egyptian and Merovingian females. The average of the eleven, +.41, is almost a unit smaller than the averaged correlations of skull width with bizygomatic breadth.

CORRELATIONS OF VERTICAL DIAMETERS

The Merovingian measurements included only three vertical diameters that might be interrelated in a manner comparable with the cranial breadths—the nasion-alveon height of the face, the height of the mandibular symphysis, the total cranial height from basion to bregma.

(Table 3). Among their intercorrelations, by far the highest is between the heights of the face and symphysis of the lower jaw. Skull height correlated with height of symphysis gives a coefficient almost a unit larger than when correlated with the height of the upper face. The female *r*'s again accord with the rank of the males.

Comparing the vertical relationships with the horizontal correlations, we find that face and skull breadth are more closely correlated than face and skull height. This might be expected since these breadth correlations are among those which Pearson describes as "due at any rate

TABLE 3

Correlation of Cranial and Facial Heights—Merovingians

TRAIT	N	M	N	F
Upper Face and Symphysis of Mandible	72	+.489	34	+.601
Upper Face and Basion-Bregma	74	+.261	118	+.184
Basion-Bregma and Symphysis of Mandible	103	+.355	55	+.246
Upper Face and Nasal	213	+.685	...	.....
Upper Face and Orbital	213	+.450	...	.....

largely, if not wholly, to 'covering' factors" (10, p. 358). However, skull and jaw height appear as little related as skull and jaw breadth; yet when we compare the two correlations, we find a reversal, the height coefficient being somewhat greater. (Tables 1 and 3). Correlations of nasal and orbital height with face height are also conspicuously larger than those of nasal-facial, and of orbital-facial breadth. In the first case, the orbital correlation of +.45 contrasted with +.20 is a fair comparison, but the identity of the nasion, a landmark of both nose and face heights makes the nasal-facial correlation largely spurious. The Pecos *r*'s for upper facial height with orbital and with nasal are also higher than for the corresponding breadths (2). Orbital and facial height correlate +.49, nasal and facial height +.87, both values greater than the Merovingian +.45 and +.68. The spurious upper facial and nasal height correlations of Pearson's Egyptian series are +.71 for both sexes.

Comparison of skull height and face height relationships is limited to one correlation and few groups. The coefficient of the basion-

bregmatic height and the upper facial diameter of 226 Greifenberg males gives +.28; 245 Tenerife males +.25; *Ca* 800 Egyptian males +.18; *Ca* 400 Egyptian females +.18. Including the two Merovingian *r*'s, male +.26, female +.18, we have six groups with a range of one unit, whereas the group difference in the two breadth correlations cited above is three times as large.

CORRELATIONS WITH LENGTH

It seemed worth while to test the significance of transverse and vertical relationships by comparing correlations with a trait in a different plane. Glabello-occipital length was therefore correlated with two selected diameters, upper facial height from the vertical plane, bizygo-

TABLE 4

Correlations

GROUP		CRANIAL LENGTH AND UPPER FACIAL	CRANIAL HEIGHT AND UPPER FACIAL	CRANIAL LENGTH AND BIZYGOMATIC	CRANIAL BREADTH AND BIZYGOMATIC
Merovingian	M	+.25	+.25	+.19	+.54
Greifenberg	M	+.22	+.29	+.18	+.60
Tenerife	M	+.48	+.25	+.55	+.52
Egyptian	M	+.26	+.19	+.38	+.37
Egyptian	F	+.29	+.19	+.31	+.34

matic breadth from the horizontal. In Table 4, where the contrasted *r*'s are presented for the five main groups of crania, it is evident that, in general, length is as closely related to vertical face height and horizontal face breadth as are the main cranial diameters in their respective planes. Equally striking are the two exceptions. Instead of equal or slightly greater relationships between skull length and bizygomatic breadth than between skull breadth and bizygomatic, the *r*'s for the Merovingian and Greifenberg male groups are lower by three and four points. To explain this divergence, it is necessary to examine the relationship of

TABLE 5

Correlation of Cranial Length and Cranial Breadth—20 Groups

r	+.6	+.5	+.4	+.3	+.2	+.1	.0
GROUP	Moorfields	Eskimo	Aino	Australian	Sioux	French	Merovingian
	Tenerife		Tasmanian	German	Melanesian	Badener	
			Egyptian M	Naqada	Whitechapel M	Greifenberg	
			Egyptian F	Russian		Pecos	
				Whitechapel F			
Per cent	10	5	20	25	15	20	5

length and total breadth of the crania in the several groups. (Tables 5 and 6). There this discrepancy continues and in more marked form. The coefficients of correlation for these two major cranial diameters are: Merovingian male —.04, Greifenberg male +.07, Egyptian female +.38, Egyptian male +.40, Tenerife male +.59. In contrast with the group ranges of one to three points in the correlations noted above, this spread of six units is impressive. Assembling all data available

TABLE 6

Coefficients of Correlation for Cranial Length and Breadth Arranged According to the Standard Deviation of Cephalic Index

GROUP		S. D. OF CEPHALIC INDEX	r CRANIAL LENGTH AND CRANIAL BREADTH
Tenerife	M	2.3	+.59
Moorfields	F	2.4	+.62
Egyptian	F	2.6	+.38
Egyptian	M	2.7	+.40
Whitechapel	F	3.0	+.35
Swedish	M	3.1	+.27
Whitechapel	M	3.3	+.24
Greifenberg	M	4.3	+.07
Merovingian	M	4.5	—.04
Pecos	M	4.8	+.09

for comparison, we have the undulating distribution of Table 5. Eleven of the 20 groups are unknown except for the r. (Martin (8), vol. II, p. 811, and Tscherpoursky (13)). Concerning the other nine, fortunately, enough knowledge is present to pursue analysis. These groups in addition to Merovingian, Greifenberg and Tenerife males, the Pecos Indians and the Egyptian males and females of Pearson's series, consist of the Moorfields and Whitechapel crania (Macdonell, 6, 7). One correlation from a living group has been included, from Lundborg and Linders' study of 47,387 Swedish conscripts (5). (Table 6). For these ten series, means and standard deviations had been calculated for cranial length, cranial breadth and cephalic index. Obviously, a comparison of means could shed no light on the problem, nor did the

standard deviations of the two correlated traits show a definite trend in relation to the *r*'s obtained. However, the size of the standard deviation of the cephalic index stands in clearcut, negative relation to the *r* of the component characters. Sigmas rise from 2 to 5 as *r*'s drop from .6 to zero. This simple logical relationship varies directly with the degree of homogeneity in the series. If there were no variation in cephalic index, the correlation of cranial length and breadth would obviously be 1.00. The students of the two series most highly correlated, the Moorfields and the Tenerife, struck by the unusual size of the *r*'s have interpreted their results in different ways. Macdonell says: "If not due to some special disturbing source in the sample, e. g. the preservation of some very small female skulls, it shows how little weight can be laid on the correlation values obtained from small series of crania." Hooton, however, recognizing the true cause in the unusual homogeneity of the Canary Island groups concludes: "A high correlation is perhaps to be expected in these diameters when, as in the present case, the series studied is predominantly mesocephalic."

Characteristic of the correlations of the crania from the island of Tenerife are the high coefficients obtained when any trait is correlated with total skull length. Equally characteristic of the Merovingian and Greifenberg series is the opposite tendency. Skull length correlated with any cranial or facial character is certain to give a low value. The character in these latter groups giving the highest average *r* in intercorrelations is, it may be remembered, the bizygomatic breadth of the face. This breadth correlates significantly with cranial breadth (.54 and .60) and very slightly with skull length (.19 and .18). These two race groups show very high variability in cephalic index (Table 6). Therefore, we can deduce from a low sigma for cephalic index, a high *r* for length and breadth and relatively high *r*'s for length with other cranial characters.

CORRELATION AND TYPE

The further analysis of correlations in extreme types of head form within a series showed consistent tendencies which seem to have some biologic meaning. When the total length of the skull and the condylo-symphysial length of the mandible were correlated for the series of 104 Merovingian males, and the corresponding series of 48 females, *r* equalled respectively +.13 and +.05. Comparative material with corre-

lations including mandible measurements was limited to the American Indian groups studied by Montelius (9). The coefficients follow: 37 male Arikara +.30, 27 female Arikara +.54, 21 male Hopi —.18, 17 female Hopi —.004. It was then decided to analyze the results further, and therefore, two series of data from the male series were selected at the extremes of head form. The first was made up of those crania with a cephalic index of 75 or below, the second was composed of those with an index of 80 or above. In these two groups, glabello-occipital length

TABLE 7

TRAITS	GROUP		TOTAL GROUP N	TOTAL GROUP r	DOLICHOCEPHALIC N	DOLICHOCEPHALIC r	BRACHYCEPHALIC N	BRACHYCEPHALIC r
Cranial Length and Mandible Length	Merovingian	M	104	+.134	45	+.324	20	+.259
	Merovingian	F	48	.050	20	.338	..	...
Cranial Length and Face Breadth	Merovingian	M	167	.186	66	.310	25	.587
	Greifenberg	M	219	.177	..	...	169	.370
	Tenerife	M	247	.549	72	.554	18	.804

was again correlated with condylo-symphysial length. The same process was repeated for the dolichocephalic female skulls; there were less than ten brachycephalic skulls accompanied by mandibles. The rise of the correlations from the totally insignificant values of +.1 obtained in the whole group to moderate association of +.3 in the skulls of extreme type is shown in Table 7.

The possibility that this striking change was due to more than chance was then tested by the selection of another correlation, bizygomatic breadth with glabello-occipital length, again a low correlation in the total Merovingian groups. This was analyzed as was the preceding correlation, for Merovingian, Greifenberg and Tenerife data. The last two were large series for which the individual data had been published by Shapiro and Hooton. They differed from the Merovingian series at points which made them valuable for comparison. The Greifenberg *r* for head length and face breadth closely approximated the Merovingian, but the series was predominantly brachycephalic and less than ten dolichocephalic crania were available for this correlation. The homo-

geneous Tenerife crania gave an r larger by .36 than the Merovingian. In each of these three divergent groups, the separation of the extreme types of head form for correlation raised the r above that obtained for the complete series. (Table 7).

It seems that this may actually indicate higher interdependence of cranial characters in the more extreme skull types. The selection of a segment of a series is certain to change the coefficient of correlation but, mathematically, there is nothing to determine the direction this change shall take. The consistent increase noted for two sets of correlations carried out in five series indicates the operation of a factor other than chance. If not statistical, we may infer it to be of biologic origin. Other correlations were not so analyzed because of expense.

TABLE 8

Correlations of Merovingian and Greifenberg Series

TRAITS	MEROVINGIAN		GREIFENBERG	
	N	r	N	r
Bizygomatic-Cranial Breadth	72	+.54	219	+.60
Cranial-Frontal Breadth	72	+.34	219	+.46
Bizygomatic-Frontal Breadth	72	+.34	219	+.46
Upper Facial-Cranial Height	74	+.26	226	+.28
Upper Facial Height-Cranial Length	74	+.25	226	+.22
Bizygomatic-Cranial Length	167	+.19	219	+.18
Cranial Breadth-Cranial Length	128	+.04	219	+.07

While the extreme types within series may affect correlation, differences in the means of diameter size and of skull form from one series to another are of little importance in determining the r's of the two series. Degree of homogeneity rather than mean size and type determines differences in correlation. The Tenerife crania in major diameters and in cephalic index, give means coincident with the Merovingian; the Greifenberg differ significantly in all characters. But it is the Greifenberg r's which correspond most closely with the Merovingian. (Table 8). The reason is obvious; the calculation of a coefficient of correlation only very remotely involves the mean of a series.

CORRELATION AND SEX

When the coefficients of 12 correlations worked out for both male and female Merovingians are compared, two tendencies are apparent,

TABLE 9

Sex Differences in Correlation—Merovingian

TRAITS	r M	r F
Bizygomatic-Cranial Breadth	.54	.48
Bizygomatic-Bigonial Breadth	.53	.37
Upper Face-Mandible Height	.49	.60
Cranial-Mandible Height	.36	.25
Cranial-Frontal Breadth	.34	.26
Bizygomatic-Frontal Breadth	.34	.19
Cranial-Bigonial Breadth	.30	.26
Cranial-Upper Facial Height	.26	.18
Cranial Length-Upper Facial Height	.25	.32
Frontal-Bigonial Breadth	.21	.14
Cranial Length-Mandible Height	.15	.16
Cranial-Mandible Length	.13	.05
	M = .325	M = .271

the general agreement in rank of the two series and the somewhat smaller size of most of the *r*'s for female crania. (Table 9). The mean difference of these traits, .054, corresponds both in size and trend with three large series analyzed by Pearson.

Group	*No. r's*	*Mean Difference Male minus Female*
Merovingian	12	.054
Naqada	25	.055
XXV-XXX Egyptian	123	.006
17th Century London	30	.033

SUMMARY AND CONCLUSIONS

The observations of cranial interrelationships determined by the coefficient of correlation may be summarized as follows:

Of the intercorrelated transverse diameters of skull and face, the more adjacent tend to give the higher *r*'s. The range of two of these correlations in 12 human groups is three units. Of the intercorrelated vertical diameters, face height and mandible height are most highly related, but the *r* for skull height with jaw height exceeds that for

skull height with face height. The range of one of these correlations in 6 human groups is one unit.

The length of the skull correlated with breadths or with heights of face and jaw gave in general *r*'s equal to those of skull breadth with face and jaw breadths and skull height with face and jaw height.

The greatest group variation in *r*'s is that for skull length and skull breadth, the inter-group range being from plus 6 to zero. The coefficients are directly related to the sigmas of the proportion of these traits, the cephalic index.

Correlation shows no difference in groups of distinct physical type as determined by size and proportions. Within a group, however, a selection of extreme types of head form raises the coefficient.

Sex differences in the coefficients appear only in the slightly greater size of the averaged *r*'s of the males. Coefficients of the same cranial characters follow the same rank in both sexes of a racial group.

The size of the coefficients of intercranial relationships seldom indicates very close dependence. Unless there is a spurious element present, an *r* of more than .5 is rare, correlations of .5 are in the main found only for adjacent characters in the same plane, and many cranial parts anatomically related give coefficients of no significance. It is interesting to compare these with correlations for segments of the body. The figures to be quoted from the series of 47,387 Swedish conscripts 21 years of age (5) are characteristic of other series. Here the coefficient of correlation for arm length and leg length is .80, for stature with shoulder breadth and with pelvic breadth, .47 and .52. In this series where the head length and head breadth relationship is .27, an equal figure .25 is obtained for head length with stature.

This study has interpreted the relationship of cranial parts within the limits of a mathematic technique. During its progress, there have arisen questions and doubts concerning the sensitivity of the instrument and the field of its application. In contemplating the final neat figure, it is difficult to recognize that correlation may sometimes be a cumbersome affair obscuring the really significant relationships between two variables, or that the striking similarities and sharp contrasts between correlations from two different groups of anatomic data can be explained by statistical rather than biologic phenomena. An expression of total group relationship which does not indicate whether a greater dependence exists in certain parts of the distribution than in others is

too coarse a measure to serve alone. Therefore, the comparison of coefficients unaccompanied by scatter diagrams or by supplementary analysis is useless. Moreover, even with these seldom available tools in hand, it is doubtful whether contrasts in the correlations of cranial characters of one group and the same characters in a second group can be interpreted in terms other than statistical, since different biologic factors operating in the two groups may produce the same expression of interrelationship.

Therefore when seeking fundamental relationships in the human skull by means of correlation, it seems wise to proceed with Dugdales' caution of sixty years ago: "being careful not to alter the facts that are congruous by the artifices of mathematical estimates."

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A STUDY OF TWINS WITH SPECIAL REFERENCE TO HEREDITY AS A FACTOR DETERMINING DIFFERENCES IN ENVIRONMENT

BY PAUL THOMAS WILSON[1]

Institute of Child Welfare, University of California

I. INTRODUCTION

IT HAS often been demonstrated that identical twins are, to a striking degree, more similar than fraternal twins; this is true of psychological as well as of physical traits. The greater intra-pair differences in body measurements, mental ability, disease records, etc., so frequently found among fraternal twins are usually attributed directly to the influence of differing heredity. But no study has ever been made of intra-pair differences in the *environments* of fraternal as compared with identical twins. Most writers have simply assumed that, as Holzinger (8) puts it, "the mean average nurture difference" is the same for twins of both types.[2]

On the basis of this assumption Siemens (13), Dahlberg (3), Holzinger (8) and others have developed their so-called "twin-method" of studying the relative influences of heredity and environment in determining individual differences. According to their reasoning, differences between identical twins are due solely to differences in environment—since their heredity is the same. The *greater* differences between fraternal twins are a consequence of their differing heredity—since the mean nurture differences are the same for twins of both types.

There are, however, *a priori* grounds for viewing with some skepticism this assumption of similar nurture differences for both types of twins. In nature, animals with differing heredity are found in different environments. Ducklings hatched in the same nest with chicks will soon be separated from them and swimming in the creek. Similarly

[1] For assistance at various stages of this study, acknowledgments are due to Professor Samuel J. Holmes, Professor Harold E. Jones and Dr. Herbert S. Conrad.

[2] Similar statements have been made by Siemens (13, p. 22), Dahlberg, (3, p. 280), Lenz and Verschuer (10, p. 425), Newman (11, p. 16).

it may be true, as Holmes (7) has suggested, that "fraternal twins by virtue of their differences (in heredity) soon get into different relations with their environment and come to experience very unlike reactions from their associates." Much the same idea is expressed by Stocks (16) in a recent paper.

It is, of course, quite obvious that environmental influences cannot be absolutely identical for the two members of any pair of twins. The twins are at times separated from each other; to some extent they eat different foods, play different games, have different contacts and different relationships with their parents and other members of society. In a previous study (9), involving interviews with the parents of twins, the viewpoint was presented that these external influences are usually more similar for identical twins than for fraternal; but the evidence assembled to support this hypothesis was not of an exhaustive character.

The object of the present investigation is to make a direct study of factors which have a bearing upon the question. If it can be demonstrated that differences in certain phases of environment are usually greater for fraternal than they are for identical twins, this fact will have a twofold significance: first, it will to some extent indicate the sources of environmental differentiation, and their relationship to hereditary factors; second, it will have a direct bearing upon methodology in the study of human heredity, particularly with reference to the use of the "twin method."

II. MATERIAL AND METHODS

The data in this report represent a part of the material secured in a series of studies of twins conducted at the Institute of Child Welfare, University of California. The sample was located through the cooperation of the city schools of Alameda, Berkeley, Oakland, and San Francisco. In an attempt to obtain a representative selection of adolescent twins, nineteen junior and sixteen senior high schools were canvassed in the school systems of these cities.

A. The Sample

The twins were located in each school through the principal's office. Particular care was made to locate not only those twin pairs that were together in a class, but also pairs of which the two members were in

different grades or different schools.[3] At an appointed time all the twins in each school were assembled to fill out data sheets (to be described later). Soon afterward, each pair of twins was taken to the school gymnasium or some other convenient place, for a short series of anthropometric measurements. After this all the intelligence test data available for each individual were obtained from the school files.

During the anthropometric examination each pair was classified as to type. The criteria used were similar to those employed by Siemens (15), Dahlberg (3), and Newman (11). This method is based upon the theory that if two members of a pair closely resemble each other in a number of characteristics, each of which is largely and independently determined by genetic factors, there is a very high probability that the two individuals have the same germinal make-up and are, therefore, of monozygotic origin. Curtius (2) has apparently demonstrated that this method is even more reliable than diagnosis based upon observations of the foetal membranes.

Newman's criteria (11) for the monozygotic origin of twins are as follows:

1. The twins must be strikingly similar in general appearance, including various intangible resemblances.
2. They must be essentially identical in hair color, texture, and form.
3. They must have the same shade of eye color and form of iris.
4. They must have the same skin color and texture (complexion) except when one is more tanned than the other.
5. They must have no marked differences in features; nor in shape of ears; nor in shape, size and arrangement of teeth.
6. They must have hands of the same type, nearly equal in size.
7. The general microscopic character of the papillary ridges in fingers and palms must be essentially the same.
8. There must be stronger cross resemblance than internal resemblance in one or more details of finger and palm patterns.
9. The presence of reversed asymmetry in handedness or hair whorl in one twin is confirmatory evidence of monozygosity but its occasional presence in unlike twins is not to be taken as an indication of monozygosity.

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[3] In some ten or twelve cases it was impossible to interview both members of a pair because of death of one member, or graduation from school, or residence in a distant community. The majority of these cases were of opposite sex pairs, and it is probable (in view of other findings) that most of the remainder were drawn from the fraternal group. All of these incomplete pairs are omitted from the sample of the present study. Thus our data will tend somewhat to accent the similarity of environment of pairs of fraternal twins.

The first six criteria were the only ones used in this study. Diagnosis was made by conference between the two examiners (the author and his assistant), at the time of examination. In this study, as in others using the same method, the large majority of pairs was readily classified in one group or the other. The examiners were, however, doubtful about the classification of 15 pairs (8 per cent of the total). These pairs were placed in an "undetermined" group and are not further considered in the present study.

TABLE 1

Ages of Twins

GROUP *	N	RANGE	MEDIAN	MEAN	S. D.
Imm	31	12.17 to 17.93	14.81	14.88±.18	1.48±.13
Iff	39	12.08 to 19.33	15.38	15.56±.19	1.73±.13
All Ident.	70	12.08 to 19.33	15.19	15.20±.13	1.64±.09
Fmm	22	12.25 to 18.33	14.33	14.68±.24	1.64±.17
Fff	47	11.93 to 18.33	15.38	15.23±.18	1.85±.12
All Frat. (like sex)	69	11.93 to 18.33	14.81	15.05±.14	1.78±.10
Fmf	55	12.08 to 20.25	15.21	15.31±.16	1.71±.10

* Imm and Iff = identical male and female pairs respectively.
Fmm and Fff = fraternal male and female pairs respectively.
Fmf = fraternal opposite-sex pairs.

In another study undertaken a few months subsequently, a third worker, J. Burke (1), had occasion to interview and classify eighty of these same pairs of twins. He used the same criteria but his diagnosis in each case was made without knowledge of the previous classification. In only *three* cases did his grouping disagree with the present one—two pairs here classed as "undetermined" he listed as fraternal, and another pair classed as "undetermined" he called identical. In no case was a pair shifted from identical to fraternal, or vice versa. Consistency of classification is not necessarily proof of validity, but there can be a high degree of certainty that errors in classification have not been sufficiently numerous to affect group comparisons.

The number, sex and average age of the twins studied are given in Table 1. The groups are comparable as far as these factors are con-

cerned. The ratio of ♂♂, ♀♀, ♂♀ pairs is 27:44:29. This agrees fairly well with the ratio found in a previous study by Wilson and Jones (20) in the same area two years previously. At that time the total school enrollment (75,013) was canvassed in the cities of Alameda, Oakland, Berkeley and Richmond, and among 471 pairs of twins the ratio 28:39:33 was obtained.

In our present sample the identicals make up 50.4±3.0 per cent of the like-sex pairs. This figure agrees closely with the proportion expected on the basis of other studies, and with the results of the earlier survey. At that time 49.0±2.5 per cent of the like-sex twins were classified as identical.

B. The Data Sheets

The sample of twins used in the present study was drawn from the public high schools. The time that these pupils could spare from their regular activities was limited, and for us to make contacts with the pupils outside of school hours would have required a prohibitive expenditure of time and money. A combination of the interview and questionnaire methods was therefore used. Data sheets were compiled which covered all the significant information it seemed possible to obtain under the circumstances. The twins (from 3 to 19 pairs per school) were assembled at a given hour in a vacant classroom, where they were seated at individual desks. The question sheets were then distributed. The writer made a few introductory remarks relative to the object of the investigation, and to work that was being done in neighboring schools. Then he asked the twins to fill in the requested information. The children were encouraged to inquire about any points in the inventory which they did not fully understand; by observation and questioning the examiners made sure that every individual was following directions correctly. All the information was obtained from each twin independently, except for some of the data concerning separations. Before answering questions of this type the children were asked to confer with their co-twins in order to check each other's memory.

Several factors were favorable to obtaining the coöperation of the twins. In many cases, the writer already had a personal acquaintance with the twins through a home visit (20, 21). Moreover, the twins were relieved to discover that the questionnaire was not a "test." Usually, too, the twins seemed to relish the opportunity to tell about

themselves and express their opinions. The seriousness and apparent conscientiousness with which they reacted to the situation were on the whole very gratifying.

III. RESULTS

A. Separations

Like-sexed twins of school age are seldom separated for any great length of time. An attempt was made, however, to get data on such separations as had occurred, and to compare identical and fraternal twins as to the length and frequency of intra-pair separations. The questions asked the twins on this subject are given in Table 2. Under each question (and to the left) the answers are listed. The number of pairs in each group and subgroup is indicated at the top of the table and under each number the proportion of each group making a given answer to any question is given in per cent. From these data the answers of the different groups can be compared. For example: 44.3±4.0 per cent of all the identical pairs had never been separated more than a day; the corresponding figure for the like-sex fraternals is 26.5±3.6 per cent, and for the male-female pairs 14.9±3.2 per cent. Conversely the data for the longer periods of separation show that while 35.7±3.9 per cent of the identicals had been separated for 8 days or more, the proportion is 51.5±4.1 per cent for the like-sex fraternals, and 70.3±4.0 per cent for the opposite-sex fraternals. In answer to the question, "How many times have you been separated from your twin for more than a day?" the reply "Never" was obtained from 43.5±4.0 per cent of the identicals, 26.1±3.6 per cent of the fraternal like-sex, and 15.7±3.3 per cent of the fraternal opposite-sex pairs.

The data concerning separations in school and grade were obtained directly from the school records. Again we find that the identicals are separated the least frequently; none of the identical pairs attended different schools, while 14.0±2.8 per cent of the fraternal like-sex and 8.9±2.6 per cent of the opposite-sex pairs were separated in this way.

The answers to Question 11 indicate how often twins attending the same school were separated in their classes. Under these conditions there was little difference between the two like-sex groups; in fact the identical pairs were somewhat more often separated than were the fraternal pairs; however there was a very high percentage of the opposite sex group that were so separated: 54.0±4.5 per cent of the mem-

TABLE 2

Separations

	IMM 31 prs.	IFF 39 prs.	TOTAL IDENTICAL 70 prs.	FMM 22 prs.	FFF 47 prs.	TOTAL FRAT. (LIKE-SEX) 69 prs.	FMF 55 prs.
Ques. 7	*What is the longest time you were ever separated from your twin?*						
1 day or less.....	42.0	46.2	44.3±4.0	28.6	25.5	26.5±3.6	14.9±3.2
2 to 8 days	29.0	12.8	20.0±3.2	14.3	25.6	22.0±3.4	14.8±3.3
8 days or more...	29.0	41.0	35.7±3.9	57.1	48.9	51.5±4.1	70.3±4.0
Ques. 10	*How many times have you been separated from your twin for more than a day?*						
Never	41.7	44.9	43.5±4.0	21.4	28.3	26.1±3.6	15.7±3.3
3 or less	35.0	34.6	34.7±3.8	42.9	31.5	35.0±3.9	23.2±3.8
4 or more	23.3	20.5	21.8±3.4	35.7	40.2	38.9±4.0	61.1±4.5
Ques. 12	*Separations in school*						
Same school	100.0	100.0	100.0±0.0	90.5	83.3	86.0±2.8	91.1±2.7
Different school ..	0.0	0.0	0.0±0.0	9.5	16.7	14.0±2.8	8.9±2.6
Ques. 11	*What classes do you have together with your twin? (Answered only when both twins attended the same school)*						
All	48.4	51.3	50.0±4.0	57.8	51.4	53.3±4.0	0.0±0.0
All but P. E. and Shop	3.2	2.6	2.9±1.4	10.5	5.2	6.9±2.1	18.0±3.5
Part	35.5	28.2	31.4±3.8	31.5	28.2	29.7±3.8	28.0±4.1
None	12.9	17.9	15.7±3.0	0.0	15.2	11.1±2.6	54.0±4.5
Ques. 13	*Do you study your lessons with your twin?*						
Usually	35.5	40.8	38.4±3.9	21.4	33.0	29.4±3.7	11.6±3.0
Sometimes	22.6	34.2	29.0±3.6	35.7	23.4	27.2±3.6	29.5±4.2
Seldom	41.9	25.0	32.6±3.8	42.9	43.6	43.4±4.0	58.9±4.5
Ques. 17	*Do you and your twin go home from school together?*						
Always	46.8	64.1	56.4±4.0	19.1	46.8	38.2±4.0	7.1±2.4
Sometimes	32.3	25.6	28.6±3.6	47.6	31.9	36.8±3.9	48.2±4.6
Seldom	21.9	10.3	15.0±2.9	33.3	21.3	25.0±4.5	44.6±4.6
Ques. 20	*Do you and your twin sleep in (different bedrooms, different beds in the same room, the same bed?)*						
Diff. rooms	12.9	5.3	8.7±2.2	23.8	5.3	11.0±2.6	94.6±2.1
Diff. beds	29.0	44.7	37.7±3.9	40.5	44.7	43.4±4.0	5.4±2.1
Same bed	58.1	50.0	53.6±4.0	35.7	50.0	45.6±4.0	0.0±0.0

TABLE 2—Continued

Separations

	IMM 31 prs.	IFF 39 prs.	TOTAL IDENTICAL 70 prs.	FMM 22 prs.	FFF 47 prs.	TOTAL FRAT. (LIKE-SEX) 69 prs.	FMF 55 prs.
Ques. 21	*Does your twin usually go to bed (before, at the same time, or after) you do?*						
Before	6.7	7.7	7.3±2.1	21.4	15.2	17.2±3.1	24.1±3.9
Same time	85.0	82.0	83.3±3.0	61.9	69.6	67.2±3.8	50.9±4.5
After	8.3	10.3	9.4±2.3	16.7	15.2	15.6±3.0	25.0±4.0
Ques. 22	*Does your twin usually get up (before, at the same time, or after) you do?*						
Before	6.7	17.9	13.1±2.7	21.4	25.5	24.3±3.5	33.0±4.3
Same time	75.0	60.3	66.6±3.8	47.6	44.7	45.6±4.0	34.8±4.3
After	18.3	21.8	20.3±3.2	31.0	29.8	30.1±3.8	32.2±4.2
Ques. 14	*If you are sent on an errand does your twin go with you?*						
Always	12.9	3.8	7.9±2.2	0.0	7.5	5.1±1.8	0.9±0.9
Sometimes	33.9	56.5	46.4±4.0	28.6	43.6	39.0±4.0	29.5±4.2
Seldom	53.2	39.7	45.7±4.0	71.4	48.9	55.9±4.0	69.6±4.3
Ques. 15	*Do you and your twin go around with the same group?*						
Always	48.4	48.7	48.6±4.0	35.7	44.7	41.9±4.0	4.5±2.0
Sometimes	37.1	44.9	41.4±4.0	54.8	28.7	36.8±3.9	29.5±4.2
No	14.5	6.4	10.0±2.4	9.5	26.6	21.3±3.4	66.0±4.3
Ques. 4	*If you go to a movie does your twin go with you?*						
Always	40.0	56.4	49.3±4.0	28.6	61.7	51.5±4.0	7.3±2.4
Sometimes	55.0	39.7	48.4±4.0	57.1	33.0	40.4±4.0	62.7±4.4
Seldom	5.0	3.9	4.3±1.6	14.3	5.3	8.1±2.2	30.0±4.2
Ques. 6	*Do you think that you are together with your twin more than ordinary brothers and sisters are together?*						
Yes	77.4	64.1	70.0±3.7	47.6	62.8	58.1±4.0	27.7±4.1
No	12.9	25.6	20.0±3.2	28.6	27.7	27.9±3.6	54.4±4.6
About same	9.7	10.3	10.0±2.4	23.8	9.5	14.0±2.8	17.9±3.5

bers of the boy-girl pairs had none of their classes together with their mates. In the schools from which our sample was taken it is customary for 'Physical Education' to be given three days a week to the boys and

girls separately. At this same period on the other two days in the week these children attend special classes, such as manual training or household science. These latter courses are usually "elective," the student being allowed to choose the one he prefers. This accounts for the fact that none of the opposite-sex fraternal twins had all their classes together.

In answer to the question "Do you study your lessons with your twin?" it was found that the identicals more frequently answered, "Usually." Most of the members of the opposite-sex pairs answered, "Seldom," with the like-sex fraternals intermediary, answering, "Sometimes." This would be expected from the data showing that the identicals more often attend the same classes. Nevertheless the fact remains that the identicals did study together more. Similar results were obtained from the question "Do you and your twin go home from school together?"

The rest of Table 2 presents data on common separations occurring in the everyday life of the twins. These data show that the identical twins more frequently slept in the same bed, went to bed and got up at the same time than did the pairs in either of the fraternal groups. Also the identical twins ran errands together oftener, and more frequently went about with the same group.

Movie attendance is one of the very few activities in which the fraternals failed to show greater separation. In answer to the question "If you go to a movie does your twin go with you?" 49.3 ± 4.0 per cent of the identicals answered "Always," as compared with 51.5 ± 4.0 per cent of the fraternal like-sex pairs.

In answer to the question "Do you think you are together with your twin more often than ordinary brothers or sisters are together?" "Yes" was the answer from 70.0 ± 3.7 per cent of the identicals, 58.1 ± 4.0 per cent of the like-sex fraternals, and 27.7 ± 4.1 per cent of opposite-sex pairs. There may have been some confusion over the difference between the answer "No" and "About the same," but in any case the relationship of the differences between the three groups is quite clear. In their own opinion, at least, the identicals are together most, the fraternal like-sex next, and the opposite-sex pairs the least.

B. Social Relationships

Some of our questions were framed with the purpose of getting data on the interaction of twins and their social environment. Anyone who

has had contact with twins of school age realizes that the mere fact of being a twin creates many peculiar social situations. There are undoubtedly many social forces which tend to keep twins together and other social forces that tend to separate them. The data presented in Table 3 indicate some of these forces and show how they act on the different types of twins. The arrangement of the data is the same as in Table 2.

The first question was "Do you dress alike?" Following this the pupils were asked "Do you like to be dressed like your twin?" and "Explain your answer." The data indicate that the identical twins were much more likely to be dressed alike than the fraternal twins of like sex. The figures indicate also that twins of both types wished to be dressed alike more often than they actually were.

The "reasons" assigned for liking or not liking to be dressed the same are significantly indicative of attitude toward their mates and toward the world at large. The answers cannot be treated statistically; some of the more common or suggestive ones are given below. No distinction is made here between the answers of individuals from identical or fraternal pairs, though it is clear that more of the "No" answers are from individuals of fraternal pairs. In some cases the sex of the pair is indicated by the answer itself.

The following are typical answers to the questions, "Do you dress alike?" and "Explain your answer."

Reasons for "Yes":

A. Desire to be alike.
   1. "Just to be alike."
   2. "Makes us look alike."
   3. "Shows that we are twins."
   4. "I like to be a twin in every way possible."
   5. "I like to look like her."
   6. "Everyone says we don't look like twins, so I like to put on the same dress."

B. Custom.
   1. "We should be dressed the same."
   2. "Twins are supposed to be alike."
   3. "To carry out the custom."

C. Social Pressure.
   1. "Everyone likes it."
   2. "Mother wants us to."

Reasons for "No":

A. Desire to be different.
   1. "Forms more personality."
   2. "I want to be individual."
   3. "I like to be different—he considers himself better."

B. Physical characteristics.
   1. "Because I'm taller and bigger."
   2. "We do not look like twins anyway."
   3. "We are different types."
   4. "She has red hair."

C. Social Pressure.
   1. "Everyone stares."
   2. "People comment."
   3. "The boys holler 'Twins'."
   4. "Otherwise the wrong one sometimes get punished."

TABLE 3

Social Relationships

	IMM 31 prs.	IFF 39 prs.	IDENTICAL 70 prs.	FMM 22 prs.	FFF 47 prs.	FRAT. (LIKE-SEX) 69 prs.	FMF 55 prs.
Ques. 1	*Do you dress like your twin?*						
Always	45.2	37.2	40.7±4.0	9.5	19.2	16.2±3.0	.....
Usually	38.7	37.2	37.9±3.9	42.9	19.1	26.5±3.5	.....
Seldom	16.1	25.6	21.4±3.3	47.5	61.7	57.3±4.0	.....
Ques. 2	*If so, do you like to be dressed like your twin?*						
Yes	48.4	60.5	55.1±4.0	26.2	42.5	37.4±3.9	.....
Indifferent	12.9	11.4	12.3±2.6	16.7	22.3	19.9±3.2	.....
No	38.7	28.1	32.6±3.8	57.1	36.2	42.7±4.0	.....
Ques. 9	*What was the occasion of the separation?*						
Sickness	22.6	25.6	24.3±3.4	9.5	25.5	20.6±3.3	16.7±3.4
Vacation	32.3	23.0	27.1±3.6	52.4	46.8	48.5±4.0	59.3±4.5
Other answers ...	3.2	5.2	4.3±1.6	9.5	2.2	4.4±1.6	9.2±2.6
Never	41.9	46.2	44.3±4.0	28.6	25.5	26.5±3.6	14.8±3.3
Ques. 16	*Do you have the same chums?*						
Yes	86.7	67.1	75.7±3.4	52.4	52.1	52.2±4.0	17.0±3.4
Sometimes	0.0	2.6	1.5±1.0	9.5	2.1	4.4±1.6	4.5±2.0
No	13.3	30.3	22.8±3.4	38.1	45.7	43.4±4.0	78.6±3.8

TABLE 3—Continued

Social Relationships

	IMM 31 prs.	IFF 39 prs.	IDENTICAL 70 prs.	FMM 22 prs.	FFF 47 prs.	FRAT. (LIKE-SEX) 69 prs.	FMF 55 prs.
Ques. 18	*Would you rather be with your twin than with anyone else?*						
Yes	72.6	65.8	68.8±3.8	52.4	71.3	65.4±4.0	35.7±4.4
Sometimes	8.1	10.5	9.4±2.4	7.1	12.8	11.0±2.6	15.2±3.3
No	19.3	23.7	21.7±3.3	40.5	16.0	23.5±3.4	49.1±4.6
Ques. 19	*Does your mother like to have you be with your twin most of the time?*						
Yes	79.0	73.7	76.1±3.4	66.7	82.6	77.6±3.4	35.8±4.4
Doesn't care	19.4	26.3	23.2±3.4	30.9	17.4	21.6±3.4	62.3±4.4
No	1.6	0.0	0.7±0.8	2.4	0.0	0.8±0.8	1.9±1.3
Ques. 23	*Which parent do you get along with best?*						
Father	4.5	6.5	5.8±1.8	2.4	8.5	6.6±2.0	9.3±2.6
No difference	75.8	79.5	77.8±3.2	69.1	61.8	64.0±3.9	63.0±4.4
Mother	17.7	11.6	14.3±2.8	26.1	26.7	26.4±3.6	26.9±4.1
Ques. 24	*Which parent does your twin get along with best?*						
Father	6.5	8.9	7.9±2.1	4.8	12.5	9.6±2.4	10.1±2.8
No difference	75.8	79.5	77.8±3.2	69.1	61.8	64.0±3.9	63.0±4.4
Mother	17.7	11.6	14.3±2.8	26.1	26.7	26.4±3.6	26.9±4.1
Ques. 25	*Does your twin get along better with your parents than you do?*						
Yes	4.8	7.7	6.4±2.0	9.5	12.8	11.8±2.6	12.7±3.0
No difference	87.1	85.9	86.4±2.8	69.1	71.2	70.6±3.8	75.5±4.0
No	8.1	6.4	7.2±2.1	21.4	16.0	17.6±3.1	11.8±2.9

When the child was asked "What was the longest time you were ever separated from your twin?" he was also asked, "What was the occasion of the separation?" Most of the answers could be classified in either of two categories. The first was illness of one of the members; e.g., "She went to the hospital"; "I had an operation." The other reason often given was a vacation or a visit; e.g., "He went to Scout Camp"; "I visited my aunt." "Illness" was given by 24.3±3.4 per cent of the identicals, 20.6±3.3 per cent of the fraternals like-sex and 16.7±3.4

per cent of the fraternals opposite-sex pairs; the corresponding percentages giving "Vacation" are 27.1±3.6 per cent, 48.5±4.0 per cent, and 59.3±4.5 per cent. Miscellaneous answers made up the remainder. Apparently the identicals were less often separated on those occasions when choice was a deciding factor. The identical twins "*chose*" to stay together.

The identicals more often "had the same chums," [4] and a few more identicals "would rather be with their twin than anyone else." But a few less of identicals than of like-sex fraternals were conscious of any desire on the part of the mother to keep them together.

The last three items in Table 3 were devised to obtain information on intra-pair differences in the social interactions of parent and child. The findings indicate that fewer identicals than fraternals were conscious of any difference between themselves and their mates, so far as social relations with their parents are concerned.

C. Food Likes

Food is an essential element of every individual's environment. Because of their "nature," animals of different species select different foods. The object here was to see if fraternal twins (with their different heredities) tended to show more differing food preferences than those found for identical twins.

A list of 40 common foods was presented to each individual with the instructions "Make a (—) before everything you dislike; and an (=) before everything you like fairly well; if you like it very much make a (++). Mark every item." It was thus possible to study intra-pair differences by comparing the replies of the twin mates.

1. Frequency of individual marks

For all twins (196 pairs) the distribution of the individual marks (totaling 15,680) was: "—" 32.77 per cent; "=" 32.57 per cent; and "++" 34.66 per cent. There was no important sex difference in the markings although for five foods [5] the extreme difference between the

[4] In order to force the child into a positive statement no intermediate answer was given on the sheets but only "Yes" and "No." However, some children wrote in a qualification, like "sometimes."

[5] These were: spaghetti, oatmeal mush, "wieners," raw onions, and maple syrup. In every one of these cases the girls gave a higher percentage of minus marks than the boys.

males and females was statistically reliable (even in these the difference was never more than five times its P.E.). This allows us to combine the data for the two sexes and compare the results for the identical, fraternal like-sex and fraternal opposite-sex groups.

2. *Control group*

For the food data, as well as for that of "preferred games" to be discussed later, data from a control group were utilized. Pairs of individuals from the sample were matched so that (a) they were both members of the same sex, (b) they differed by not more than 12 months in age nor 20 points in I.Q.; and (c) had parents of similar economic and social status (as judged by the occupation of the father). Later computations indicated no reliable correlation between intra-pair differences in I.Q. and food preferences. Thus the members of a pair in this matched group were similar in most respects except those peculiar to twinness; they did not have the same parents nor live in the same homes. The number, sex, and age data for the matched group are given in Table 4; the figures may be compared with those for the true-twin groups in Table 1.

TABLE 4

Number, Sex and Age Data of Matched Pairs

N	SEX	MEAN AGE	S. D. (AGE)
42 prs.	Males	14.95 ± .11 yrs.	1.19 ± .08 yrs.
98 prs.	Females	15.51 ± .09 yrs.	1.36 ± .07 yrs.

3. *Frequency of different combinations of marks*

Comparison of the answers of twin mates indicates how they agree on any given food. (a) Complete agreement is indicated where both members give the same marks (both +, both =, or both —). (b) Slight disagreement is indicated when one twin is indifferent (=) while the other likes the food (+), or dislikes it (—): this is termed a "difference of 1." Strong disagreement is indicated when one twin marks the food (—) and the other twin (+): this is termed a "difference of 2." There were six possible combinations of marks by the two twins for any food; viz., + +, = =, — —; + =, — =; and + —.

The frequency of these different combinations in the whole list of foods is stated in per cent by groups in Table 5. One observes a distinct

TABLE 5

Foods Liked—Showing Frequencies of the Different Combinations, Expressed in Per Cent

GROUP	AGREEMENT			SLIGHT DISAGREEMENT		STRONG DISAGREEMENT
	−−	==	++	+=	−=	+−
Imm	18.6	19.9	19.1	17.0	17.4	8.9
Fmm	15.3	18.1	19.8	18.1	15.9	12.9
Iff	24.7	13.7	21.2	16.8	15.2	8.3
Fff	17.6	11.5	21.7	20.3	18.3	10.6
All Identical	22.3±3.4	15.8±3.0	20.4±3.2	16.9±3.0	16.1±3.0	8.5±2.3
F Like-sex	16.9±3.0	13.5±2.8	21.2±3.3	19.7±3.2	17.6±3.1	11.3±2.6
F Opp.-sex	16.9±3.4	13.2±3.1	17.7±3.5	21.7±3.8	18.9±3.6	11.7±3.0
Matched Pairs..	15.7±2.1	15.9±2.1	10.7±1.8	22.5±2.4	20.5±2.4	14.7±2.1
Chance	10.7±1.8	10.6±1.8	12.0±1.9	22.6±2.4	21.3±2.4	22.7±2.4

tendency for the identicals to show the highest percentage in those combinations indicating agreement and, conversely, the lowest percentage of combinations in those showing disagreement. In other words, the identicals show the greatest similarity in food tastes. The groups rank in the following order: identicals, fraternal like-sex, fraternal opposite-sex, matched pairs and, least of all, chance.

4. Intra-pair correlation on food likes

This degree of similarity greater than chance can be expressed numerically by use of Pearson's mean square contingency method, using the formula $C = \sqrt{\frac{S-N}{S}}$ When this method is applied to these data the following values of C are obtained [6] (Table 6).

[6] In computing C for the different groups the chance combinations were obtained separately for each group, from the different percentages of the "+," "=," and

TABLE 6

C—Values for Intra-Pair Agreement (and Disagreement) on Food Likes

GROUP	*C*
Identical	+ .49
Fraternal (like-sex)	+ .39
Fraternal (opposite-sex)	+ .34
Matched pairs	+ .24

The *C* value of +.24 for the matched pairs can be interpreted as a measure of the amount of agreement on the "test" of food likes, for pairs of individuals matched as to age, sex, I.Q., and social position. The increase in *C* value for the other groups may be attributed to factors peculiar to twins. As usual, the greatest similarity is shown among the identicals.

5. *Reliability of Test of Food Likes*

It is desirable to obtain a measure of the consistency or reliability of intra-pair differences in food likes. This has been done by the "split-half" technique, using the data for all groups of twins together. As a necessary preliminary, the following numerical values were assigned, respectively, to every case of agreement (or disagreement) between members of twin pairs: the value 0 to the combinations $--$, $==$, and $++$ indicating agreement; the value of 1 to the combinations $+=$ and $-=$ indicating mild disagreement; and the value of 1.5 to the combination $+-$ indicating stronger disagreement. The validity of these values is indicated by the fact that the scores obtained for each twin pair on the total foods test, correlate highly ($r = .91 \pm .02$) with scores obtained by an exact sigma-score weighting of each combination.[1] In order to obtain comparable "split-halves," the various foods were listed in order of the twins' preference; alternate items were matched, thus giving two lists of foods of equal average preference. A difference score for each pair of twins in the sample was secured for each of these two lists of foods. The consistency of the intra-pair differences, as shown by the correlation (Pearson *r*) between the score on the first

"–," marks in the given group (Table 5). With six categories the highest possible value of *C* is .913. Garrett (5).

[1] This result was obtained in the Imm group, taken as representative of other groups with respect to this problem.

half and the score on the other half, is .56 ± .03; this, by use of Spearman's formula ($r_s = \frac{2r_h}{1+r_h}$) (5) gives a coefficient of reliability for the total test of .72. This may be considered a rather low reliability for a test of food preferences; but low reliability cannot detract from the significance of the differences between the identical and fraternal groups shown in Table 6, since ".....when a difference between groups is empirically found, that difference is *more* significant in proportion as the measuring device is *less* reliable" (Tryon (18)).

D. Activities

The data under this head are of two types: (1) ratings, by each twin, of 17 different types of general activities; (2) ratings on 90 specific games and activities. Both lists were taken from Terman (17) with some modifications.

1. General Activities

In the first list each twin was asked to rate each of the 17 types of general activity on a five point scale, in order . . . "to show how well you like to do that thing." The ratings of each activity by each first-born twin of a pair were then plotted against the corresponding ratings of the second-born twin, and coefficients of contingency computed. *C* for the identical twins is .63, for the fraternal like-sex, .49. The degree of relation between ratings by the fraternal opposite-sex pairs was not computed, since the sex difference would invalidate any comparison.

2. Specific Games and Activities

(*a*) *Frequency of different combinations of marks*

For the second list, consisting of ninety specific games or activities, the instructions were: "Make a + before each thing you like to do; if you like it very much make two crosses + +." This made it possible to measure the intra-pair difference in the twins' preference for specific activities in a manner similar to that used for the food likes. Using O to indicate the failure to mark an item it is found that marks of a pair of twins on any one item may be any one of six possible combinations: O O, + +, + + + +, O +, + + +, or O + +. From these figures one can readily see that the most common single mark is O, since most of the items were not rated. This, of course,

TABLE 7

Preferred Activities

Showing the Percentage of Items Given Either a + or ++ by the Individuals of the Different Groups

Imm	23.86%	Iff	17.79%	All Ident.	20.47±3.3%
Fmm	26.16%	Fff	21.92%	F Like-sex	23.23±3.4%

All Males*	24.74±4.0%
All Females*	20.03±3.0%
All Like-sex Twins	21.82±2.4%
Opposite-sex Twins	20.73±3.7%

*From like-sex pairs.

TABLE 8

90 Specific Games and Activities

Showing Frequencies of the Different Combinations, Expressed in Per Cent

GROUP	PERCENTAGE FREQUENCY OF					
	OO	++	++++	+O	+++	O++
Males						
Ident.	67.93	5.59	4.80	12.36	5.16	4.16
Frat.	64.18	5.24	4.08	14.44	7.09	4.97
Females						
Ident.	75.44	3.76	3.36	9.78	3.90	3.76
Frat.	68.99	4.18*	4.47*	13.19	4.44	4.73
All like-sex						
Ident.	72.09	4.57	4.00	10.94	4.46	3.94
Frat.	67.66	4.51	4.35†	13.42	5.27	4.79
Fraternal						
Opposite-sex	67.19	3.02	1.51	15.75	4.10	8.43

*Of the 12 comparisons of the identical with the fraternal groups (male vs. male and female vs. female pairs) all but two (*) show greater similarity in the direction of the identicals. When the sex groups are combined and the total identical and fraternal groups are compared, the difference is in the "expected" direction in all but one (†) of the six comparisons.

would be expected. The list is extensive, and different items appeal to children of different sex and ages. The frequencies of the different combinations are given in Table 8, where the figures for the identical and fraternal groups may be compared.

A comparison of percentage of marks under each combination shows that in all but two cases (marked *), the identicals are more similar than the fraternals. That is, they show a higher percentage of agreements (O O, + +, + + + +) and lower percentages of disagreement (O +, + + +, O + +). The difference is not great in any case but is always, except as noted, in the expected direction.

(*b*) *Intra-pair correlations*

The frequency of the different individual marks varies somewhat for the different groups, as is shown in Table 9.

TABLE 9

Frequencies, in Per Cent, of the Individual Marks for the Different Groups

GROUP	PERCENTAGE OF		
	O	+	++
Imm	76.19	14.35	9.46
Fmm	73.89	16.00	10.11
Iff	82.21	10.60	7.19
Fff	77.95	13.00	9.05
Fmf	79.28	12.95	7.77

From these percentages a chance or "independence" value for the various combinations can be derived for each group. With the chance frequencies known, a measure of the co-variation between the pair members can be computed by Pearson's mean square contingency method, as was done for the Food Likes.

The *C* values for the different groups are given in Table 10. For the like-sex groups the differences between the identicals and the fraternals are not great but the figures indicate that the identicals are more similar.

(*c*) *The abbreviated lists*

As has been previously shown (Table 7) the average child marked only a few of the 90 separate items. There were 23 activities for the

boys and 18 for the girls which had been marked by at least one member of half of the pairs (male and female groups separately).[8] These activities—23 for the boys, and 18 for the girls—were more familiar to

TABLE 10

C—Values for Agreement (and Disagreement) on 90 Specific Games and Activities

(Chance or "independence" value computed from the frequency of the various single marks (O, +, ++) in the respective groups)

GROUP	"C" VALUE
Imm	+ .53
Fmm	+ .47
Iff	+ .51
Fff	+ .49
Fmf	+ .26

the pupils, and their ratings on them are probably more reliable than on those of the less popular items. The sections immediately below are devoted to an analysis of results for the two abbreviated lists.

(*d*) *Control group*

Control data for the abbreviated lists of games and activities were obtained by means of matched pairs, in the same way as was done for the foods. The criteria for selection as a match were the same as previously, except that the maximum intra-pair difference in I.Q. was reduced to 10 points. The ages of the matched groups are given in Table 11.

TABLE 11

Ages of Matched Pairs

	N	MEAN C. A.	S. D.
Males	100 prs.	14.84	1.48 yrs.
Females	100 prs.	15.36	1.62 yrs.

[8] The opposite-sex pairs are not included in this study of the abbreviated list.

(e) Reliability of the abbreviated lists of specific games and activities

The reliability of the abbreviated "test" was determined by the "split-half" technique in the same way as was done for the data on foods. The reliability coefficients are as follows:

Males (half test) ..... $r = .65 \pm .05$; r (whole test) $= .79$
Females (half test) ..... $r = .49 \pm .05$; r (whole test) $= .66$

(f) Frequency of different combinations of marks

The frequency with which the various combinations of ratings or marks were found in the various groups, for the abbreviated tests, is summarized in Table 12. Here, as with the data on separation, there

TABLE 12

Percentage Frequency of Different Combinations of Marks on the Abbreviated Lists of Games and Activities *

	MALES			FEMALES	
Agreement	Imm	58.91	Agreement	Iff	54.70
	Fmm	40.99		Fff	52.30
	Matched	39.60		Matched	41.12
	Chance	33.49		Chance	34.26
Slight disagreement	Imm	35.06	Slight disagreement	Iff	36.89
	Fmm	45.96		Fff	37.33
	Matched	40.96		Matched	42.50
	Chance	45.06		Chance	42.26
Strong disagreement	Imm	6.03	Strong disagreement	Iff	8.40
	Fmm	13.04		Fff	10.39
	Matched	19.43		Matched	16.39
	Chance	21.45		Chance	23.48

* The combinations (+ + + +, + +, O O) are bracketed as "Agreement"; the combinations (O +, + + +) are bracketed as "Slight Disagreement"; the combination (O + +) is listed as "Strong Disagreement."

is a consistent tendency for the combinations of agreement to be arranged in the order of: identicals, fraternals, matched pairs, and chance —with the identicals showing the greatest frequency of agreement. In the arrangement for the disagreeing combinations, the order is reversed.

(g) Intra-pair correlation

Table 13 shows the agreement between members of pairs in their preference for the selected games and activities.

TABLE 13

C—Values for Agreement in Preference for Selected Games and Activities

GROUP	*C*
Imm	+ .51
Fmm	+ .24
Matched (males)	+ .13
Iff	+ .44
Fff	+ .41
Matched (females)	+ .19

Here, as in the case of *C* values for all the games and activities (Table 8), the differences between groups are all in the "expected" direction. For the boys, at least, the differences between the identical and fraternal groups are probably large enough to be statistically reliable.

E. Miscellaneous Data

1. School subjects preferred

To the question "What school subjects do you like best?" the pupils answered: "Algebra," "Shop," "Physical Education," and so forth. The following figures indicate how often both members of a pair gave first choice to the same subject:

Imm	*Fmm*	*Iff*	*Fff*	*All Ident.*	*F Like-sex*	*Fmf.*
33%	24%	36%	15%	36±3.8%	18±3.1%	15±3.2%

Thus, 33 per cent of all the Imm twins agreed with their mates on the best-liked subject. The data on school subjects 'liked least' may be summarized in a similar manner:

Imm	*Fmm*	*Iff*	*Fff*	*All Ident.*	*F Like-sex*	*Fmf.*
50%	18%	55%	27%	53±4.0%	24±3.4%	21±3.7%

Part of the differences between the various twin groups may be accounted for by the fact that more of the fraternal twins attended different classes or even different schools. However, this explanation is hardly adequate to account for all of the differences. Furthermore, no matter what the cause of these intra-pair differences, the fact that identical twins are in greater agreement still stands, and has its significance.

2. Preferred occupation

In answer to the question "What occupation do you hope to follow after leaving school?" the agreements on first choice were as follows:

Imm	*Fmm*	*Iff*	*Fff*	*All Ident.*	*F Like-sex*	*Fmf.*
42%	27%	57%	26%	51±4.0%	26±3.6%	2.3±1.4%

In the following percentage of cases, the first choice of one twin was either the first or second choice of his mate:

Imm	*Fmm*	*Iff*	*Fff*	*All Ident.*	*F Like-sex*	*Fmf.*[9]
44%	26%	59%	35%	53±4.1%	37±3.9%	3.1±1.6%

3. Favorite color

The percentages of pairs in each group agreeing on the same color as favorite are:

Imm	*Fmm*	*Iff*	*Fff*	*All Ident.*	*F Like-sex*	*Fmf.*
39%	25%	46%	25%	43±4.0%	25±3.5%	37±4.4%

Here the Fmf group shows more pairs agreeing than the fraternal like-sex. It is possible that members of the like-sex fraternals more often selected (and hence came to prefer) different colors in order to differentiate their own belongings. For the opposite-sex pairs this would be unnecessary.

F. Interrelation of Intra-pair Differences in Environment

In order to study the interrelation of various environmental differences, correlations were computed between the various difference scores. We have already discussed the derivation of the difference scores for foods liked and games preferred. Similarly an "S" or separation score was computed, based on ten different items having to do with intra-pair separations. These items are covered by questions 1, 4, 7, 10, 11, 13, 14, 16, 17 and 20 on the last page of the question sheet. The twins' answers for each item were rated as "alike," "partly alike" or "different." The difference score for the pair was then obtained by adding the number of "different" items to one half the number of

[9] Two pairs only. In one, both members put 'painting' as first choice; in the other 'aviator' was first choice of the boy and second choice of the girl.

"partly alike." The maximum score so computed was 10 (if all the items were answered differently by a pair of twins).[10]

Product-moment correlations were then computed between these different measures of intra-pair differences. For the like-sex twins the following values of r were obtained.

TABLE 14

Inter-correlation of the Various Difference Scores

VARIABLES COMPARED	GROUP	r	GROUP	r
"S" vs. Food	All Ident.	.08±.08	All Frat.—like sex ..	.14±.08
"S" vs. Games	Imm	.25±.11	Fmm	.10±.15
	Iff	.10±.11	Fff	.21±.10
Food vs. Games	Imm	.30±.11	Fmm	.09±.15
	Iff	.12±.12	Fff	.05±.11

These correlations are all very low and in no case statistically reliable. However, they are all positive. The inference might be that if larger groups were studied a slight though reliable correlation would be found between intra-pair differences in amount of separation, foods liked, and games preferred. In other words, if one phase of a pair's environment differs more than the average, other phases of their en-

TABLE 15

Correlation Between Age and Difference Scores

VARIABLES COMPARED	GROUP	r	GROUP	r
Age vs. "S"	Imm, Iff	.19±.08	All like-sex ...	.24±.05
	Fmm, Fff	.34±.07		
Age vs. Food	.....	.....	All like-sex ...	.05±.06
Age vs. Games	Imm, Fmm ...	.08±.09	.....	.....
	Iff, Fff	.04±.07	.....	.....

[10] Inspection of scattergrams indicated that there was only a slight positive correlation between intra-pair differences in any of these measures.

vironment are also likely to differ somewhat from the average. This tendency, however, is by no means clearly marked in the present sample.

The correlation between the age of the twin pairs and the various difference scores is given in Table 15.

Evidently age had no effect in determining the difference scores for foods and games, but was positively correlated with separations. The r values for the identical and fraternal groups taken separately suggest (although the difference has a low reliability) that the increase in separations with age is greater among fraternal twins.

G. Summary of Findings

1. In nearly all of the given measures of environment, the group of identical twins showed less intra-pair difference than either the like-sex or opposite-sex fraternals.

2. This greater intra-pair similarity of the identicals varied with the phase of environment. For example there was little difference between the groups in "going to the movies" and a great deal of difference in "dressing alike."

3. Intra-pair differences in separations showed a reliable correlation with age. The indications are that this correlation is higher in the fraternal than in the identical group.

4. The difference scores for separations, food likes, and games preferred showed a tendency toward a low but positive correlation with each other.

IV. DISCUSSION

A. Validity of the Data

Two questions may be raised concerning the validity of the data. First, did so-called "halo effect" influence the answers of the twins? Identical twins quite possibly want to be like each other (as indicated by the answers previously quoted for the question "Do you dress alike?"); do they, in consequence, report greater similarities with their mates than actually exist? In the present data, this is not very likely, for in the first place, most of the questions called for information only about each individual twin himself—no comparison with the mate being requested or implied. In the second place, "halo" probably has negligible influence on responses to such questions of objective fact as "What

classes do you have together?" In the third place, except for a few items (See II. *B. The data sheets*) all the twins in each school filled in the data sheets independently and simultaneously: no twin knew what his mate was writing: how, then, could "halo" exert any significant effect?

A more important problem concerns the relation between reported vs. actual intra-pair differences in the twins' environment. Objective measures of differences in environment are certainly desirable. But until these are forthcoming the best must be made of such measures as are available. The opinions a person expresses as to his likes or dislikes for a food or a game may not correlate perfectly with his behavior at the table or on the playground. However, his opinions in such matters are undoubtedly contributory factors in determining his choice of environment. Even if intra-pair differences in behavior were smaller (or greater) than those in testimony, there is no reason to suppose that the relationship of the different twin groups would be reversed.

To what extent would the results of the present study hold for another sample of twins living in a different locality? In a locality of comparable genetic and environmental heterogeneity, we should expect results similar to those obtained in the urban California sample. But a study of twins living in (say) the Kentucky mountains would probably yield smaller average intra-pair differences; (a) because the Kentucky stock would be genetically more homogeneous; and (b) because the opportunity would be smaller for differing genetic predispositions to manifest themselves in environmental "choice." On the other hand, in a community with greater genetic and environmental heterogeneity, larger intra-pair differences would be expected.

With respect to the urban California sample of the present study, it seems safe to accept the essential conclusions indicated by the data. The groups of identical and fraternal twins were adequately large and fairly sampled; the measures of environment, while based on testimony, still have a reasonable validity; and all the measures used (even though nearly independent of each other) point in essentially the same direction.

B. Relation of Differences in Heredity to "Choice" of Environment

From the geneticist's point of view the primary difference between the identical and fraternal twins of our sample is that the identical twins have the same heredity. The general geographical and social milieu was

the same for both kinds of twins. Our data indicate, however, that in many respects the identical pairs lived under more similar conditions than the fraternals. This fact must be attributed ultimately to the influence of their heredity which led, or forced, them to "select" more similar environments.

The *environment* in which an individual develops is not an entity but is a complex of many phases, such as the school he attends, the children he associates with, the food he eats, etc. In this study an attempt has been made, within limits, to isolate some of these phases. Now it is to be expected that intra-pair differences in heredity would have more effect on some of these phases than on others. The data indicate that this has occurred. Thus, the percentages of intra-pair differences in "going to the movies together" are about the same for both the identical and the fraternal like-sexed groups. On the other hand when it came to the "longest time you were ever separated from your twin" there is a decided difference between the groups; the fraternal like-sexed pairs were more often separated for long periods than were the members of identical pairs. It is clear that dissimilarity in genotype is more effective in determining differences in some phases of environment than in others.

An individual's *heredity* is also a complex made up of a great number of factors or "genes." The "influence of intra-pair differences in heredity" so commonly referred to in this paper means the *average* influence of *all* these genetic differences. If the influence of the hereditary units could be isolated for study it would undoubtedly be found that certain hereditary factors are more effective than others in determining the individual's "choice" of environment. Intra-pair differences in the hereditary factors for sex would be of major importance, (a comparison of the data for the like-sex fraternals with those for the fraternals of opposite-sex supports this presumption), while intra-pair differences in the hereditary factors for such characteristics as eye or hair color would usually be of less importance.

C. Relation of the Findings to the Twin Method

The fact that intra-pair differences in environment are demonstrably greater for fraternal twins has an important bearing upon the validity of the "twin method." For example, in a study of the disease records of twins (21) the writer found that in practically all the so-called children's diseases, identical pairs more often had the disease simul-

taneously than fraternal pairs. An investigation by Verschuer (19) showed similar results. He concluded that the similar heredity of the identicals had given them similar resistance to infection, and he uses this as an illustration of the effect of heredity upon differences in physiological immunity. Undoubtedly heredity does often determine differences in immunity; but if it is true, as our data indicate, that identical twins are usually together more than fraternal twins it seems reasonable to ascribe part of their greater similarity in these diseases to their greater similarity in opportunity for infection.[11]

The twin method measures only the *total* effect of heredity upon intra-pair differences in a structural or a functional trait. It does not show how this effect has been brought about. Before any generalizations concerning the relative influences of heredity and environment can be made from results of use of the "twin method," the following fact must be taken into consideration: Differences in heredity exert their influence in two ways: (1) *directly,* by modifying the structural or functional characteristics of the individuals; and (2) *indirectly,* by causing the individual to choose or to be forced into different environments, which, in turn modify the development of structural and functional traits.

Whether the indirect influence is significant depends upon the purpose of the study. If one wishes to know the total influence of "different heredity" upon the incidence of disease in a given community, the twin method may be applied directly. But if one wishes to *isolate the factors* determining individual differences in disease, the twin method is of less value.

The relative importance of this indirect—as compared with the direct—influence of heredity may be expected to vary with different structural and functional traits. It is improbable that the indirect influence of heredity is ever of great significance in determining intra-pair differences in a trait like body height; but the indirect influence may be of very considerable importance in determining intra-pair differences in emotional characteristics, or in ability to score in an achievement test on "Nature Study." Whether this indirect influence is great or small is not indicated by the twin method.

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[11] Also to the fact that other similarities in their environment would tend to make short term variations in bodily resistance more consistent among the identicals.

Stocks (16) has pointed out that the average intra-pair differences in both heredity and environment are always relatively slight for twins, as compared with unrelated individuals; and consequently that care must be taken in using the results of the twin method as a basis for generalization upon the relative influences of heredity and environment in determining individual differences. Now if there is added the difficulty of distinguishing between the direct and the indirect influences of heredity, it would seem that the twin method of studying the origin of individual differences has limitations that cannot be disregarded.

The writer does not wish to underrate the value of twins as material for study, but he does wish to emphasize certain limitations of the "twin method" which seem to have escaped attention. He believes that the best way to use twins for studying the origin of individual differences is through some modification of the "co-twin control" method of Gesell (6). The problem of "heredity versus environment" is one which can have no general answer; we must look, instead, for differences in specific traits, considered in relation to specific differences in heredity and environment.

V. SUMMARY

Certain phases of the environment of twins were studied in respect to intra-pair differences. The sample consisted of 70 identical, 69 like-sex fraternal and 55 opposite-sex twin pairs enrolled in junior and senior high schools. Most of the data were obtained by a combination interview and questionnaire method, and concern such differences in environment as: attending different schools and classes; the length, frequency and causes of separations from each other; differences in social relations at home and with their friends; differences in foods liked and in types of activities preferred.

The data indicate that compared with single-born individuals the environmental conditions surrounding a pair of twins of any type are usually very similar for both members; however, in most of the phases of environment studied, these conditions differ, on the average, more for fraternal than for identical pairs. As a rule the greatest differences occur among the twin pairs of opposite sex.

The greater dissimilarities in environment of the fraternal pairs may be attributed in part to the influence of their different hereditary makeup, demonstrating the influence of hereditary predisposition upon the individual's "choice" of environment.

The data indicate that this influence of heredity upon the individual's "choice" of environment varies *specifically* with: (1) his heredity; (2) the phase of environment in question; and (3) the opportunities that his general milieu offers for the operation of "choice."

In many previous studies of twins the assumption has been made that intra-pair differences in environment are, on the average, equal for identical and fraternal pairs. The present study indicates that this assumption is unjustified, and consequently certain modifications should be made in conclusions based upon this premise.

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CONTRACEPTION AND FERTILITY IN 4945 MARRIED WOMEN. A SECOND REPORT ON A STUDY OF FAMILY LIMITATION[1]

BY RAYMOND PEARL

INTRODUCTION

IN SEPTEMBER 1932 there was published a preliminary report[2] on the coöperative investigation of family limitation which we have been carrying on for several years. That first report dealt chiefly with a detailed account of the plans and methods of the study. It was possible at that time to present little in the way of results, and that little of no great significance, chiefly because of the fact that we had then been able to make only the merest beginning on the enormous job of tabulating the mass of intricate and complicated data. For a sample of 2000 women in total (of whom but 1824 were married) crude data were presented on the frequency of the practice of some kind of contraception, and on the associated differences in pregnancy and birth rates, together with somewhat more refined data upon a number of other points of less marked interest.

It is now possible to present a further progress report upon a sample of 6000 cases,[3] these being the first 5000 cases in the order of their

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[1] From the Department of Biology of the School of Hygiene and Public Health of The Johns Hopkins University; and the Division of Research of the Milbank Memorial Fund. The substance of this paper was presented at the Annual Meeting of the Milbank Fund in New York on March 14, 1934.

[2] Pearl, R. Contraception and fertility in 2000 women. HUMAN BIOLOGY, Vol. 4, pp. 363-407, 1932. An abstract of this report by the same author appeared in the *Quarterly Bulletin of the Milbank Memorial Fund*, Vol. 11, pp. 37-60, January 1933, under the title "Preliminary notes on a coöperative investigation of family limitation."

[3] I am greatly indebted to the loyal aid of the following members of the staff of this department in the laborious computations preliminary to coding and punching the cards for mechanical tabulation, and for other help in connection with the project: Miss Marjorie E. Gooch, Dr. John R. Miner, Dr. T. I. Edwards, Miss

collection (and therefore including the 2000 previously discussed) and the 26th thousand collected. The 26th rather than the 6th thousand was added for the purpose of seeing whether the later cases were giving statistical ratios similar to the earlier ones. Of these 6000 cases 4945 pertained to married women living in wedlock, and these alone are considered here.

As has already been said, a complete and detailed account of the plan of the investigation, the manner in which the data were collected, the safeguards taken to ensure a maximum of accuracy in the original records, and the personnel involved in the enterprise has been given in the earlier report. Therefore it will not be repeated here. It will suffice here to say that the records pertain to the complete reproductive histories, up to the time of record, of women delivered of the products of their latest pregnancies in some urban hospital in the eastern United States, the original records being made by medically trained members of the staffs of the hospitals coöperating. In the nature of the case each woman involved in the investigation has been pregnant at least once.

The statistical methodology of this report is the same as that of the first report except in one respect. This is that further study of the whole matter has led to the revision of the method of calculating pregnancy rates. The new method[4] which is used in this present report has been described as follows:

> What we really want as a measure of pregnancy-rate is the answer, for each individual woman and constructively for the group, to the following question: What proportion of all the ovulations experienced during the period of observation resulted in the fertilization of an ovum or ova and pregnancy? On the basis of our present knowledge of the physiology of reproduction it is possible to construct a measure of the pregnancy-rate which will answer the question to a degree of approximation sufficiently close to the actuality for all practical statistical purposes.
>
> In proceeding to set up this new rate let us first consider certain underlying physiological matters.

S. A. Gould, Miss Ruth DeWitt Pearl, and Mrs. Augusta K. Hibbitts. Except for Mrs. Hibbitts, who devoted her whole time to the project, the others have cheerfully given up a significant part of their time, at the sacrifice of their own research interests, to help the project along.

I also wish to acknowledge with deep gratitude the continued financial support the Milbank Memorial Fund has given to the work.

[4] Pearl, R. Factors in human fertility and their statistical evaluation. *Lancet*, Vol. II for 1933, pp. 607-611.

(*a*) It is well established that normally the human female ovulates once, and once only, in each menstrual cycle. While it may be the fact though it has not yet been conclusively demonstrated, that some women may occasionally menstruate but not ovulate, as has been shown to be the case in monkeys by Corner and Hartman, this must be so rare an occurrence if it occurs at all that it may be neglected in statistical practice. Any effect of so neglecting it would be to make the stated pregnancy-rate slightly lower than its true value.

(*b*) From (*a*) it follows that the number of ovulations in a year will normally be determined by the average length of the menstrual cycle. This is usually stated to be 28 days, and there is a great deal of accumulated evidence that, statistically speaking, this is extremely close to the average figure. For example, Kelly found 942 out of 1000 women reporting a 28-day interval. Heyn reported the same interval for 63.5 per cent of 1684 women. Sanes found 75 per cent menstruating regularly and 72 per cent of these at 28-day intervals. Recently Allen and King have emphasized the variability of the interval, but upon calculating the biometric constants for King's own data for 354 menstrual intervals, derived from two groups of women ranging from 17 to 35 years, we find the following results:

Mean interval = 28.41 ± .17 days
Median interval = 27.94 ±. 21 days
Standard deviation = 4.83 ± .12 days
Coefficient of variation = 17.0 ± .4 per cent.

Plainly with a probable error of mean and median of the order of four to five hours on the basis of a sample of only 354 intervals no serious error will be made by taking 28 days as the average length of the menstrual cycle for statistical purposes. This gives 13.04 ovulations per woman per year. Considering the approximate nature of the calculation, in that all individual variation in respect of the menstrual interval is going to be neglected, no harm will be done by dropping the decimals and taking 13 as the normal average number of ovulations per year.

(*c*) A woman normally does not ovulate during the time she is pregnant, nor during the puerperium (the period between parturition and the complete involution of the uterus).

We may then set up the pregnancy-rate as follows:

Let M = the total period (in years) during which a woman engages in copulation, between puberty and the menopause (for practical purposes the duration of marriage within the same limits—that is, between puberty and the menopause); and

P_1 = duration of time (in years) she spends in the pregnant state, and regardless of the manner of its termination (by term birth, or abortion, etc.); and

T = number of times she becomes pregnant during the time-period M; and

P_2 = duration of time (in years) she spends in the puerperal state (taken to a rough approximation as $.04T$ or $.04(T-1)$ when, as is the case in our records, the period of observation and record ends with the date of the termination of a pregnancy).

Then $M - P_1 - P_2$ = duration (in years) of exposure to risk of pregnancy, and

$$\frac{100\,T}{13\,(M - P_1 - P_2) + T}$$

$= R_p$ = pregnancy-rate per 100 ovulations.

This pregnancy-rate may take any value between the limits zero and 100. For the completely sterile mating ($T=0$) it will be $R_p=0$. The more fertile the women the higher will be the rate.

In principle this pregnancy rate is the same as the original one used in our first report, except for the addition of the constant multiplying factor for ovulations, which as developed in the formula has the effect of confining the limits of variation of the pregnancy rate between 0 and 100 per cent, and making the physical interpretation of the rate more consistent and intelligible.

SOME GENERAL CHARACTERISTICS OF THE PRESENT SAMPLE

Race. Of the 4945 married women in the present sample 4177, or 84.5 per cent, are *whites,* and 767, or 15.5 per cent, are negroes, and for one there was no record of race.

There are, thus, only about one-half as many negroes proportionately in this larger sample as there were in the first sample of 2000. It was predicted in our first report, for reasons there set forth, that a larger sample would show a diminished proportion of negroes.

TABLE 1

Geographical Distribution of Cases in Present Sample

STATE	WHITES		NEGROES	
	Number	Per cent	Number	Per cent
Illinois	1056	25.2	66	8.6
Maryland	825	19.8	198	25.8
Pennsylvania	679	16.3	230	30.0
New York	572	13.7	120	15.6
Minnesota	328	7.9	4	.5
Missouri	173	4.1	58	7.6
Wisconsin	160	3.8	1	.1
Ohio	145	3.5	31	4.0
Tennessee	66	1.6	42	5.5
District of Columbia	49	1.2	..	..
Michigan	47	1.1	..	..
Indiana	46	1.1	2	.3
Kentucky	31	.7	15	2.0
Totals	4177	100.0	767	100.0

Geographical Distribution. Table 1 shows the distribution of the women in the present sample by the states in which they were delivered of the products of their last pregnancy at the time of record.

Table 1 tells its own story, and requires little comment beyond pointing out that the women in the present sample have a quite different geographical distribution than those of the smaller sample reported on earlier. Seventy-five per cent of the whites, and 80 per cent of the negroes in the present sample belong to the four states Illinois, Maryland, Pennsylvania, and New York. But the general scatter is sufficient so that it may fairly be said that the present data do not reflect solely the condition of any one small region of the country.

Economic Status. Table 2 shows the distribution of the women in the present sample relative to economic status. The classes are defined in detail in our first report (*loc. cit.*, p. 377).

TABLE 2

Economic Status of 4945 Families

CLASS	WHITES		NEGROES	
	Number	Per cent	Number	Per cent
Very poor	510	12.2	347	45.2
Poor	1951	46.7	381	49.7
Moderate circumstances	1358	32.5	39	5.1
Well-to-do and Rich	358	8.6	...	...
Totals	4177	100.0	767	100.0

The percentage distributions as to economic status are shown graphically in Fig. 1.

In comparison with the smaller sample of the first report (*loc. cit.* p. 387) the present sample shows generally a somewhat higher economic status in the case of the whites, and a slightly lower one in the case of the negroes. Thus in the case of the whites there are 12.2 per cent in the "Very Poor" class as against 12.5 per cent in the earlier sample; 46.7 per cent as against 50.6 per cent in the "Poor" class; 32.5 per cent as against 34.2 per cent in the "Moderate circumstances" class; and finally 8.6 per cent as against 2.6 per cent in the combined "Well-to-do" and "Rich" classes.

It was emphasized in our first report that the economic status distribution was probably distorted as a result of the fact that the data were collected during the lowest depths of the general economic depression. It was suggested (*loc. cit.* p. 387) that: "In many cases in the records skilled artisans, for example, who in good times would fall into the

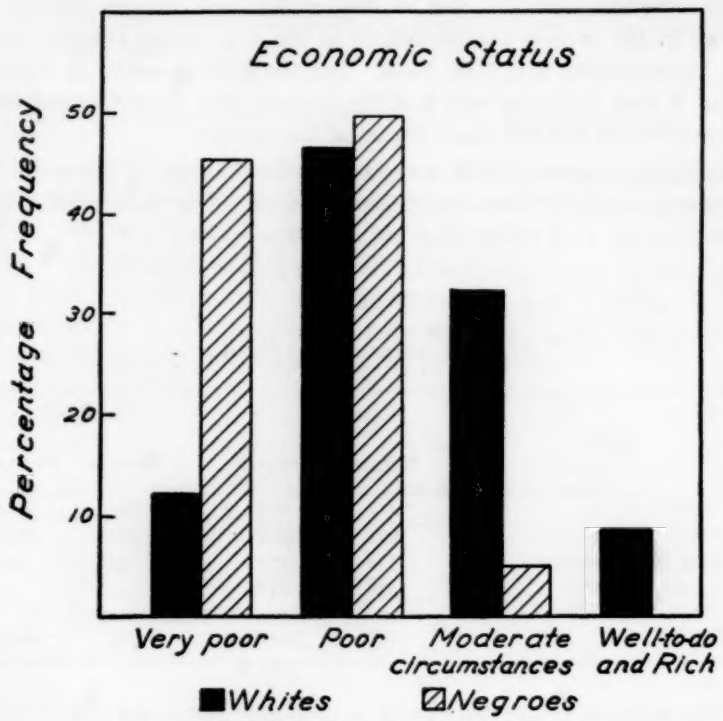

FIG. 1. DISTRIBUTIONS OF WOMEN IN SAMPLE AS TO THEIR ECONOMIC STATUS

'Moderate circumstances' group, had been long unemployed and were in actual fact 'poor,' and in some cases 'very poor' at the time the records were made."

It is now possible to bring support to this view from the more analytical tabulations that have been made from the present larger sample. Table 3 distributes the material into three broad occupational classes, in accordance with the classification of occupations recently

presented by the writer.[5] These three broad occupational classes are defined as follows:

I. Owners, managers, officials, and professional men.
II. Skilled and semi-professional workers.
III. Laborers—unskilled and semi-skilled.

The underlying idea is to contrast *primarily* two groups of persons, namely those (I) who, on the whole, are situated at or near the top of things in the existing social organization, and those (III) who, by and large, find themselves at or near the bottom in the same social organization. This leaves a third class (II); persons who are, on the whole, neither very near the top nor the bottom, and who, if they are sometimes thought and sometimes think themselves worse off than those in class I, are plainly and admittedly better off, on the whole, than those in class III.

The distinction between classes I and III is a real and fundamental one. By and large—that is to say in a statistical sense and with some admitted exceptions—the individuals falling in class I have much higher incomes and standards of living than those in class III; incomes in fact high enough—again with individual exceptions—so that they have quite definite marginal resources which not only give them a feeling of relative security as regards biological survival, but also make possible education for themselves and their children and indulgence in various luxuries and pleasures.

The occupational distributions are shown graphically on a percentage scale in Fig. 2.

The totals in Table 3 do not agree with those in Table 2 because in 48 cases among the whites and 8 among the negroes occupation was not intelligibly recorded.

TABLE 3

Occupational Distributions of Husbands of Women in Present Sample

OCCUPATIONAL CLASS	WHITES		NEGROES	
	Number	Per cent	Number	Per cent
I	656	15.9	16	2.1
II	2606	63.1	190	25.1
III	867	21.0	553	72.8
Totals	4129	100.0	759	100.0

[5] Pearl, R. A classification and code of occupations. HUMAN BIOLOGY, Vol. 5, pp. 491-505, 1933.

By comparison of the percentages of Tables 2 and 3 it is seen that while 79 per cent of the white husbands fall into occupational classes I and II taken together, only 41.0 per cent of the white families have an economic status in the combined "Moderate Circumstances," "Well-to-do," and "Rich" classes. The difference between these two percentages may be not unfairly taken as a rough index of the extent to which the depression reduced income and resources in the social group which the English call "middle class."

The occupational distribution of the whites in Table 3 does not differ very widely from that of the total occupied male population of

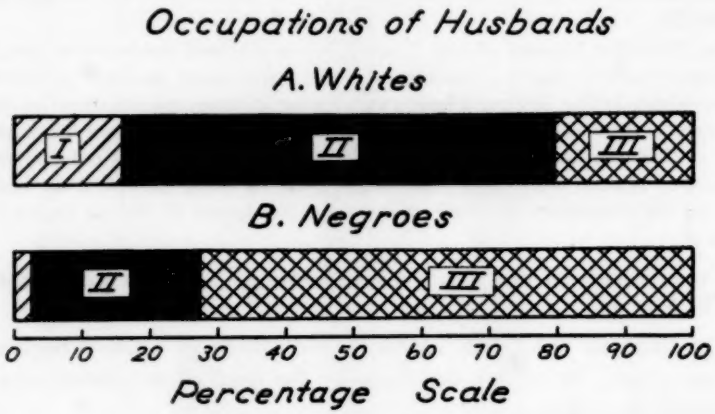

FIG. 2. OCCUPATIONAL DISTRIBUTIONS OF HUSBANDS.
Class I = Owners, managers, officials, and professional men. Class II = Skilled and semi-professional workers. Class III = Laborers — unskilled and semi-skilled.

New York City in 1930, which was (*loc. cit.*, p. 496): Class I, 18.7 per cent; Class II, 53.7 per cent; Class III, 27.6 per cent.

The difference between the white and negro occupational distributions of Table 3 is striking, but about what would be expected, I think. Nearly three-quarters of the negroes fall in Class III, and an insignificant proportion in Class I.

Religion. Keeping always in mind that the material of this study comes almost exclusively from large urban populations, the distribution of the women as to religion shown in Table 4 is of some interest.

That the populations from which this sample was drawn are urban is reflected in the fact that more than half the white women are either

Catholic or Jewish. The relatively high percentage of Catholics is in spite of the fact that no specifically Catholic hospital was included in collecting the data. Apparently Catholic women go to specifically Protestant or non-sectarian hospitals to be delivered of their babies much more frequently than the writer, at least, would have expected.

Amongst the negroes just over a half of the women were Baptists, and just over a quarter were Methodists. This, of course, is the sort of result that would have been expected.

It is to be understood that in Table 4 each denomination is inclusive of all its branches, sects, or churches. That is the Catholics include

TABLE 4

Religious Denominations of Women in Present Sample

RELIGION	WHITES		NEGROES	
	Number	Per cent	Number	Per cent
Catholic	1671	40.00	59	7.7
Jewish	642	15.37	..	..
All others not specified here	544	13.02	82	10.7
Lutheran	434	10.39	3	.4
Methodist	372	8.91	200	26.1
Baptist	221	5.29	387	50.5
Episcopalian	136	3.26	21	2.7
Presbyterian	124	2.97	12	1.6
None	33	.79	3	.4
Totals	4177	100.00	767	100.

Greek and various other sorts of Catholics besides Roman. And the same thing is true for all the other specified denominations.

Education. Inasmuch as the frequency of the practice of contraception is presumably in some degree definitely correlated with the degree of general enlightenment of any population group, it will be well to present some data about the extent of the schooling experienced by the women in the present sample. This is done in Table 5, where education and religion appear in a double entry table, so that it may be possible to get at least some indication about the extent to which so-called religious prejudices against contraception are reinforced or weakened by ignorance or intellectual enlightenment.

The entries in Table 5 are arranged in descending order of percentage attending college or university in the case of the whites; and in descending order of percentage attending high school in the case of the negroes.

Figure 3 tells in graphic form the essential points of Table 5 so far as concerns white women. The solid black portion of each 100 per cent bar gives the percentage of the white women in this sample belonging to

TABLE 5

Extent of Formal Education of Women in Various Religious Denominations in the Present Sample

A. Whites

RELIGION	HIGHEST STAGE OF FORMAL EDUCATION RECEIVED									
	Illiterate		Elementary		High School		College or Univ.		Totals	
	No.	%	No.	%	No.	%	No.	%	No.	%
Presbyterian..	1	0.8	45	36.3	52	41.9	26	21.0	124	100.0
Episcopalian..	..	..	62	45.6	53	39.0	21	15.4	136	100.0
All others not specified here	5	0.9	227	41.7	245	45.1	67	12.3	544	100.0
None	2	6.1	17	51.5	10	30.3	4	12.1	33	100.0
Methodist ...	4	1.1	177	47.6	154	41.4	37	9.9	372	100.0
Baptist	1	0.5	129	58.4	71	32.1	20	9.0	221	100.0
Jewish	26	4.0	328	51.1	253	39.4	35	5.5	642	100.0
Lutheran	2	0.5	288	66.4	125	28.7	19	4.4	434	100.0
Catholic	49	2.9	1211	72.5	373	22.3	38	2.3	1671	100.0
Totals	90	2.2	2484	59.4	1336	32.0	267	6.4	4177	100.0

B. Negroes

Lutheran	..	..	..	..	3	100.0	..	..	3	100.0
Episcopalian..	..	..	9	42.9	10	47.6	2	9.5	21	100.0
Presbyterian..	..	..	7	58.3	5	41.7	..	..	12	100.0
Methodist ...	8	4.0	122	61.0	64	32.0	6	3.0	200	100.0
Catholic	4	6.8	38	64.4	16	27.1	1	1.7	59	100.0
All others not specified here	8	9.8	52	63.4	21	25.6	1	1.2	82	100.0
Baptist	13	3.4	272	70.2	89	23.0	13	3.4	387	100.0
None	..	..	3	100.0	..	..	..	..	3	100.0
Totals	33	4.3	503	65.6	208	27.1	23	3.0	767	100.0

the indicated religious denomination whose formal schooling extended only to elementary school or was less than that amount. The cross-hatched portion of each bar shows the percentage of the white women

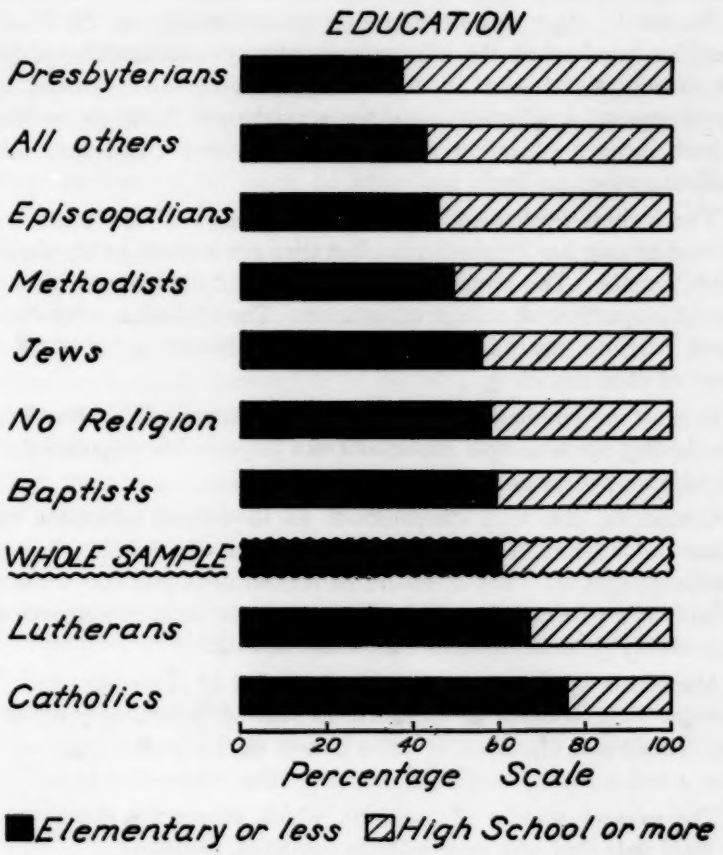

FIG. 3. AMOUNT OF FORMAL EDUCATION OF THE WHITE WOMEN IN THIS SAMPLE ADHERING TO THE INDICATED RELIGIOUS DENOMINATIONS. FOR FURTHER EXPLANATION SEE TEXT

who had attended high school or who had also gone on afterwards to college or university. In short, the length of the black bars represents the sum of the percentages in the Illiterate and Elementary columns of Table 5, and the cross-hatched bars the sum of the percentages of the High School and College or University columns of Table 5.

The most striking and important result from Table 5 and Figure 3 is that in this whole sample of white women 61.6 per cent had never got beyond elementary schools. The implications of this fact are far-reaching in relation to their practice of contraception subsequently to be discussed. Any real or thorough understanding of the biological principles involved in the efficient use of any contraceptive technique now known would seem to make a somewhat greater demand in the way of general intellectual enlightenment than is likely to be attained by such meager education as is afforded by our elementary schools, excellent as they no doubt are.

The highest percentage of college attendance in the white women is found among the Presbyterians, but they are a small group absolutely in this sample. The same also applies to the Episcopalians, who stand next in proportion of college attendance. The Catholics, who form the largest religious group in this sample, are the lowest group of all in the extent of their schooling.

It must be emphasized again that the women with whom we are here dealing are a sample collected from large *urban* populations only, and with the economic status already described.

Comparing the total distributions as to formal education of the whites and negroes there is less difference, on the whole, than might have been expected. But it should be remembered that the similarity is probably more formal than real. Negro schools, even in northern cities, are probably generally poorer than white schools.

Magnitude of Exposure to Risk; Duration of Marriage; and Times Married. The concept of exposure to risk of becoming pregnant has been defined and discussed in detail in two earlier papers (*loc. cit.* footnotes 2 and 4 *supra*) and need not be further elaborated here.

The present sample of material, which represents about one-fifth our total data that will eventually be reported, includes:

14,666.6 person-years of exposure to risk of becoming pregnant, among the *whites,* and

2,838.7 person-years exposure to risk of becoming pregnant, among the *negroes,* and

17,505.3 person-years of exposure to risk of becoming pregnant, for the *whole sample.*

These exposures indicate that the present sample is roughly equivalent to what one would get by observing the total normal reproductive

activity of the population of a city of about the size of Buffalo for a period of one year.

The exposures upon which the present report is based are plainly more respectable statistically than those of our first report. They lead to the following average exposures per woman:

Average number of years of exposure to risk of pregnancy per *white* woman = 3.51 years.

Average number of years of exposure to risk of pregnancy per *negro* woman = 3.70 years.

Average number of years of exposure to risk of pregnancy per woman for the whole sample = 3.54 years.

The similarity of average duration of exposure to risk of pregnancy in the whites and the negroes is striking.

The average duration of marriage up to the time of record among these women is as follows:

Mean duration of marriage in whites = 5.72 years

Mean duration of marriage in negroes = 6.44 years

Mean duration of marriage in all women in sample = 5.83 years.

From these data it appears that the white women in this sample have, on the average, spent about 2.2 years, or 38.6 per cent of their whole married lives in the business of being pregnant and bearing children, while the negro women have spent about 2.7 years, or 42.5 per cent of their married lives in the same way.

The number of times these women have been married is shown in Table 6.

The figures of Table 6 indicate plainly that so far in their married careers the women in this sample have mainly got along with one husband.

TABLE 6

Times Married

MARRIAGES	WHITES		NEGROES	
	Number	Per cent	Number	Per cent
One marriage only	4074	97.5	722	94.1
Two marriages only	100	2.4	44	5.7
Three marriages only	3	.1	1	.1
Totals	4177	100.0	767	99.9

THE FREQUENCY OF CONTRACEPTIVE EFFORTS

In our first report the objective of the investigation was stated to be to get some light on two questions (*loc. cit.*, p. 367) as follows:

1. To what extent statistically is any sort of contraceptive technique, device, or habit actually practised in a defined sample of the population of the United States at the present time?

2. What is the quantitative effectiveness exhibited by the various contraceptive techniques, considered both separately and all together, in reducing the relative frequency of pregnancy, as these techniques are actually used in a defined sample of the population of the United States at the present time?

Let us now see what the present sample of data contributes to the first of these questions.

In coding the extensive and manifold information on the original record cards a distinction has been made between contraceptive *genus* and *species*. By contraceptive genus is meant how, in general, contraception has been practiced; and by contraceptive species what particular device or method or combination of devices and methods was used. The distinction will be made clearer by the presentation of the entire contraceptive genus code, and the beginning and samples from the contraceptive species code.

CONTRACEPTIVE GENUS CODE

Code No.	*Way in which contraception was practised*
B	No information
X	Practice of contraception intermittent without statement of reason for intermittence
0	No contraception practiced
1	Contraception regularly and steadily practiced without intermittence
2	Contraception practice intermittent through carelessness
3	Contraception practice intermittent through dislike
4	Contraception practice intermittent through planning for children
5	Contraception practice intermittent through carelessness and dislike
6	Contraception practice intermittent through carelessness and planning
7	Contraception practice intermittent through carelessness and dislike and planning
8	Contraception practice intermittent through dislike and planning
9	Contraception practice intermittent for other reasons

PART OF CONTRACEPTIVE SPECIES CODE

Code No.	*Contraceptive methods and/or devices used*
BBB	No information
XXB	Observer regards information as unreliable

000 No contraception
001 Coitus interruptus only
002 Condom only
003 Pessary alone only
004 Pessary with medicated jelly only
005 Pessary with douche only
006 Medicated vaginal suppositories or jellies only
007 Douche alone—water only
008 Douche alone—medicated only
009 Intra-uterine mechanical device only
010 "Safe period" only
011 Any other method only
012 Coitus interruptus and/or condom together or alternatively

436 Pessary alone and/or pessary with medicated jelly and/or pessary with douche and/or medicated vaginal suppositories or jellies, together or alternatively in any combination as to time.

For purposes of presenting the data in this paper the classes of the contraceptive genus code have been combined into four broad groups as follows:

Cont. Genus Group A = Code No. 0 = No contraception

Cont. Genus Group B = Contraception regularly and steadily practiced without intentional intermittence. Code No. 1.

Cont. Genus Group C = Code Nos. 4 + 6 + 7 + 8 = Contraceptive practices intermittent for reasons wholly or partly connected with deliberate planning for children.

Cont. Genus Group D = Code Nos. X + 2 + 3 + 5 + 9 = Contraceptive practices intermittent for reasons wholly other than deliberate planning for children (except for Code No. X, of which there were negligibly few cases).

From a careful study of the original data it appears that of these four Contraceptive Genus Groups A is the most homogeneous, with D, C, and B following in the order named in comparative homogeneity relative to contraceptive practices and the motives and events lying behind the intermissions and failures of these practices. Contraceptive Genus Group B includes chiefly cases where contraceptive methods were regularly used without conscious or intended intermission for

planned children or any other reason, but failed regularly or occasionally to prevent conception in fact. It was set up with the intention to include *only* such cases. But unfortunately this category also probably includes some (relatively few) cases where contraceptive practice was intermittent because of planning (and possibly for other reasons) but without the fact having been specifically so reported. Study of the original records indicates that the proportion of such cases is not large, and probably diminished steadily and almost to the vanishing point as the observers became better trained and more experienced in the course of the work. There is nothing that can be done about the matter now; it is impossible now to go back and check up doubtful cases. The most that can be done is to recognize clearly the ambiguous character of Group B, and exercise corresponding caution in drawing inferences from its figures.

Contraceptive Genus Groups C and D have been set up as they are for the purposes of this preliminary report solely as a practical expedient. In a sample of the size of the present one a number of the subgroups in the Cont. Genus code have too small frequencies to be of any significance by themselves. In the final analysis of the whole material each one of the 12 rubrics of the Cont. Genus Code will be dealt with separately, but to attempt this on a sample of less than 5000, as the present sample is, would be futile.

Over two-thirds of the white women in Cont. Code C fall under the code number 4. Code numbers 7 and 8 included in the C group, have very small frequencies. Code number 6 has a higher frequency than 7 and 8, but falls much below that of number 4. The net result of lumping code numbers 6, 7 and 8 with 4 in this report is plainly to minimize the results as to the effect of intelligent and precisely performed contraception upon pregnancy and birth rates. The procedure adopted in setting up Cont. Genus Group C weights unfavorably the records of those women belonging to code number 4, who practice contraception carefully, intelligently, and persistently with intermissions only for planned and wanted pregnancies. The records of these code number 4 women are compelled by the present grouping to carry along the burden of the women who had the same intentions as they did, but were more careless in their performance. Since, however, the actual numerical burden imposed by the women of code numbers 6, 7, and 8 is not large the results from Cont. Genus Group C women will be treated in this progress report as though the group were homogeneous

and consisted only of women belonging strictly to code number 4. The errors made by so doing, insofar as concerns effects upon pregnancy and birth rates, will be in the direction of understatement rather than of exaggeration.

Contraceptive Genus Group D is formally and categorically more homogeneous than Group C, so far as concerns motivation of intermission of contraceptive practices. It includes a majority of the women who are ever careless practitioners.

It is hoped that with the above exposition of the defects consequent upon the system of contraceptive genus grouping adopted in this progress report the readers of this paper will not be too harshly critical

TABLE 7

Frequency of Practice of Contraception Among 4932 Married Women

RACE	CONTRACEPTION NOT PRACTICED (GROUP A)		CONTRACEPTION PRACTICED IN SOME FORM REGULARLY OR INTERMITTENTLY (GROUPS B+C+D)		TOTALS	
	No.	%	No.	%	No.	%
Whites	2280	54.7	1886	45.3	4166	100
Negroes	569	74.3	197	25.7	766	100
Totals	2849	57.8	2083	42.2	4932	100

of it, but will be willing to wait for the presentation of the whole material. Practical considerations made it desirable to find out at this time as much as possible about the trends of the results of the investigation. Consequently the grouping plan was adopted as a temporary expedient to arrive at an approximation.

The simplest and most general expression of the frequency of contraceptive practice among this sample of women is presented in Table 7.

The totals of Table 7 differ from those of most of the preceding tables because of the fact that in the cases of 11 whites and one negro the records as to contraceptive practices were incomplete.

It is at once apparent that in this larger sample the percentage of women practicing contraception is higher than that shown by the 2000

TABLE 8

The Practice of Contraception in Relation to Economic Status

A. Whites

CONTRACEPTIVE GENUS GROUP	VERY POOR		POOR		MODERATE CIRCUM-STANCES		WELL-TO-DO AND RICH		TOTALS	
	No.	%	No.	%	No.	%	No.	%	No.	%
A. No contraception	343	67.3	1191	61.2	669	49.4	77	21.7	2280	54.7
B. Regular and steady practice of contraception	59	11.6	323	16.6	276	20.4	78	22.0	736	17.7
C. Contraceptive practice intermittent mainly for planned children	68	13.4	262	13.4	325	24.0	169	47.6	824	19.8
D. Contraceptive practice intermittent for reasons other than planning	39	7.7	172	8.8	84	6.2	31	8.7	326	7.8
Sub-totals (B+C+D). Contraception practiced	166	32.7	757	38.8	685	50.6	278	78.3	1886	45.3
Totals (A+B+C+D). All cases	509	100.0	1948	100.0	1354	100.0	355	100.0	4166	100.0
B. Negroes										
A. No contraception	263	76.0	275	72.2	31	79.4	...	..	569	74.3
B. Regular and steady practice of contraception	30	8.7	45	11.8	4	10.3	...	..	79	10.3
C. Contraceptive practice intermittent mainly for planned children	8	2.3	20	5.2	3	7.7	...	..	31	4.0
D. Contraceptive practice intermittent for reasons other than planning	45	13.0	41	10.8	1	2.6	...	..	87	11.4
Sub-totals (B+C+D). Contraception practiced	83	24.0	106	27.8	8	20.6	...	..	197	25.7
Totals (A+B+C+D). All cases	346	100.0	381	100.0	39	100.0	...	..	766	100.0

cases of the first report (*loc. cit.*, p. 394). For the married white women the percentage has risen from 36.6 to 45.3; and for the married negroes from 18.5 to 25.7. The increase is plainly relatively greater for the negroes than for the whites. For the whole sample together 42.2 per cent practiced contraception in one form or another. It was anticipated when the first sample of 2000 was studied that a larger sample of the material would show higher contraceptive rates, chiefly because it would be sure to have a greater proportion of persons in the

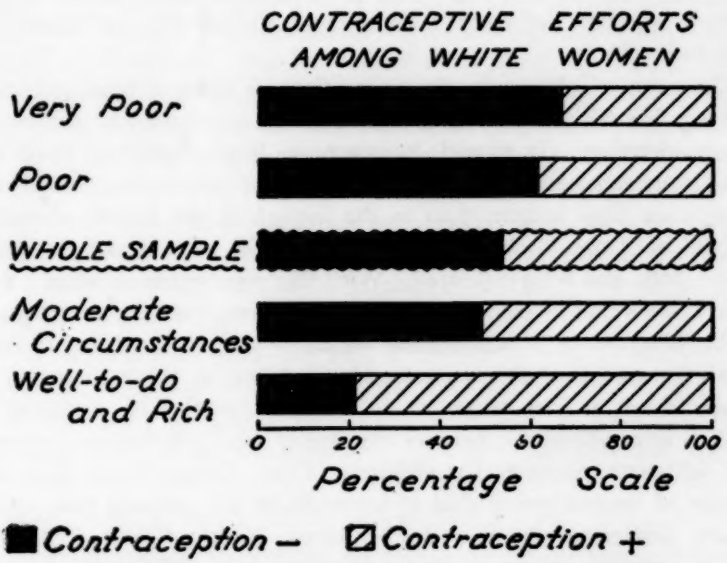

FIG. 4. SHOWING THE INCREASING PROPORTION OF WHITE WOMEN PRACTICING CONTRACEPTION (CROSS-HATCHED PORTION OF BARS) AS ECONOMIC STATUS IMPROVES

higher economic brackets. This expectation is borne out by the present results.

Table 8 subdivides the material more finely relative to contraceptive genus and economic status.

It is evident from Table 8 that the degree of prevalence of contraceptive practices in this sample of women is definitely associated with their economic status, at least so far as concerns the whites. As we go from the lowest to the highest of the four economic categories here exhibited the percentage of white women within each category who

Totals (A+B+C+D). All cases ..... 346 100.0 381 100.0 39 100.0 ... .. 766 100.0

practice contraception in one way or another steadily increases, from 32.7 per cent among the Very Poor to 78.3 per cent among the Well-to-do and Rich. The relations are shown graphically in Figure 4.

Figure 4 suggests that generalizations regarding the proportion of whole populations of women who practice contraception can have but little real significance. In the present case it is of no great import to say that among the 4166 white women of this whole sample 54.7 per cent did not practice contraception, when it is seen that in one differentiated group of these women 78.3 per cent made contraceptive efforts, while in another definitely differentiated group only 32.7 per cent made such efforts.

The rates of change in the proportion of white women practicing contraception with improving economic status are worthy of more careful consideration. It should, however, be kept clearly in mind that the absolute numbers are small in some of the sub-classes, and that in consequence final judgment as to the import of the figures should be reserved until the whole material, of which the present sample is only about a fifth, has been tabulated. With this reservation in mind we see from Table 8 that in this sample of white women the relative frequency of the practice of contraception regularly and without intermission (*Cont. Genus Group B*) rises steadily as economic status rises, but on the whole not as fast or as far as does the practice of contraception which is intermittent for reasons that are in whole or in part connected with deliberate planning for children (*Cont. Genus Group C*). The practice of contraception that is intermittent for reasons that do not involve deliberate planning for children (*Cont. Genus Group D*) does not sensibly change as economic status rises. The frequencies for this type of contraceptive behavior are substantially horizontal. It relates chiefly to people who are intermittent in their contraceptive efforts through carelessness. It suggests that under the thraldom of the sexual urge the economically better off folk contain among their numbers a residue of about the same proportion of people who, though well intentioned about contraception, are reckless upon occasion. It will be extremely interesting to see whether this suggestion is borne out by the whole material when it is tabulated.

Amongst the negroes of the present sample the relationship between contraceptive efforts and economic status appears to be somewhat less marked than among the whites, a result that accords with general expectation, I think. But a definite conclusion on the point is not

warranted yet. In view of the facts, first, that the proportion of negro women who have ever made any contraceptive efforts is much smaller than among the whites; and, second, that our total sample of negroes so far tabulated is small, it results that in the contraceptive genus groups for women practicing contraception the numbers are generally too small to yield reliable percentages.

In the present sample 1583, or 38.0 per cent of the white women had experienced pregnancy but once in their lives up to the time of record, while the remaining 2583, or 62.0 per cent, had experienced two or more pregnancies. Among the negroes the corresponding figures are 201, or 26.2 per cent, women who had experienced their first (and only) pregnancies, and 565, or 73.8 per cent, who experienced two or more pregnancies. It thus appears that this sample of women delivered in hospitals is not only heavily weighted with first pregnancies (and first births) but that the whites are more heavily weighted in this series than the negroes. It is important to see what effect this has upon contraceptive practices. The necessary data are given in Tables 9 and 10, which are constructed on the same plan as Table 8, for whites and negroes respectively.

It is evident that with the still finer subdivision of the present limited sample in Tables 9 and 10, the absolute numbers in the subclasses of women practicing contraception become in some cases too small to have any reliability whatever. This is particularly true for the Very Poor white primigravidae, and for the negroes generally. Having due regard to these limitations the data of Tables 9 and 10 suggest that:

1. The percentage of women *not practicing* contraception is *higher* among the primigravidae than among those who have been pregnant two or more times. This is true for both whites and negroes, and within each economic group. The differences in both races are largest in the Very Poor class, tend to become progressively smaller in the higher economic classes, and are, in the whites, smallest in the Well-to-do and Rich class.

2. Conversely the percentage of women *practicing* contraception is *lower* among the primigravidae than among those who have been pregnant two or more times, in both whites and negroes and in all four economic classes.

The trends of these differences are shown graphically for the white women in Fig. 5.

TABLE 9

The Practice of Contraception in Relation to Economic Status Among White Women

I. Women who had experienced only one pregnancy

CONTRACEPTIVE GENUS GROUP	VERY POOR		POOR		MODERATE CIRCUM-STANCES		WELL-TO-DO AND RICH		TOTALS	
	No.	%	No.	%	No.	%	No.	%	No.	%
A. No contraception	115	81.0	504	72.0	338	56.7	35	24.0	992	62.7
B. Regular and steady practice of contraception	9	6.3	110	15.7	110	18.5	44	30.1	273	17.2
C. Contraceptive practice intermittent mainly for planned children	12	8.5	44	6.3	108	18.2	54	37.0	218	13.8
D. Contraceptive practice intermittent for reasons other than planning	6	4.2	42	6.0	39	6.6	13	8.9	100	6.3
Sub-totals (B+C+D). Contraception practiced	27	19.0	196	28.0	257	43.3	111	76.0	591	37.3
Totals (A+B+C+D). All cases	142	100.0	700	100.0	595	100.0	146	100.0	1583	100.0
II. Women who had experienced two or more pregnancies										
A. No contraception	228	62.1	687	55.0	331	43.6	42	20.1	1288	49.9
B. Regular and steady practice of contraception	50	13.6	213	17.1	166	21.9	34	16.3	463	17.9
C. Contraceptive practice intermittent mainly for planned children	56	15.3	218	17.5	217	28.6	115	55.0	606	23.5
D. Contraceptive practice intermittent for reasons other than planning	33	9.0	130	10.4	45	5.9	18	8.6	226	8.7
Sub-totals (B+C+D). Contraception practiced	139	37.9	561	45.0	428	56.4	167	79.9	1295	50.1
Totals (A+B+C+D). All cases	367	100.0	1248	100.0	759	100.0	209	100.0	2583	100.0

TABLE 10

Totals (A+B+C+D). All cases	367	100.0	1248	100.0	759	100.0	209	100.0	2583	100.0

TABLE 10

The Practice of Contraception in Relation to Economic Status Among Negro Women

I. Women who had experienced only one pregnancy

CONTRACEPTIVE GENUS GROUP	VERY POOR		POOR		MODERATE CIRCUM-STANCES		WELL-TO-DO AND RICH		TOTALS	
	No.	%	No.	%	No.	%	No.	%	No.	%
A. No contraception	64	86.4	87	79.0	15	88.2	...	..	166	82.5
B. Regular and steady practice of contraception.....	5	6.8	11	10.0	2	11.8	...	..	18	9.0
C. Contraceptive practice intermittent mainly for planned children	1	1.4	6	5.5	...	..	...	..	7	3.5
D. Contraceptive practice intermittent for reasons other than planning	4	5.4	6	5.5	...	..	...	..	10	5.0
Sub-totals (B+C+D). Contraception practiced.....	10	13.6	23	20.0	2	11.8	...	..	35	17.5
Totals (A+B+C+D). All cases	74	100.0	110	100.0	17	100.0	...	..	201	100.0
II. Women who had experienced two or more pregnancies										
A. No contraception	199	73.1	188	69.4	16	72.8	...	..	403	71.4
B. Regular and steady practice of contraception.....	25	9.2	34	12.5	2	9.1	...	..	61	10.8
C. Contraceptive practice intermittent mainly for planned children	7	2.6	14	5.2	3	13.6	...	..	24	4.2
D. Contraceptive practice intermittent for reasons other than planning	41	15.1	35	12.9	1	4.5	...	..	77	13.6
Sub-totals (B+C+D). Contraception practiced.....	73	26.9	83	30.6	6	27.2	...	..	162	28.6
Totals (A+B+C+D). All cases	272	100.0	271	100.0	22	100.0	...	..	565	100.0

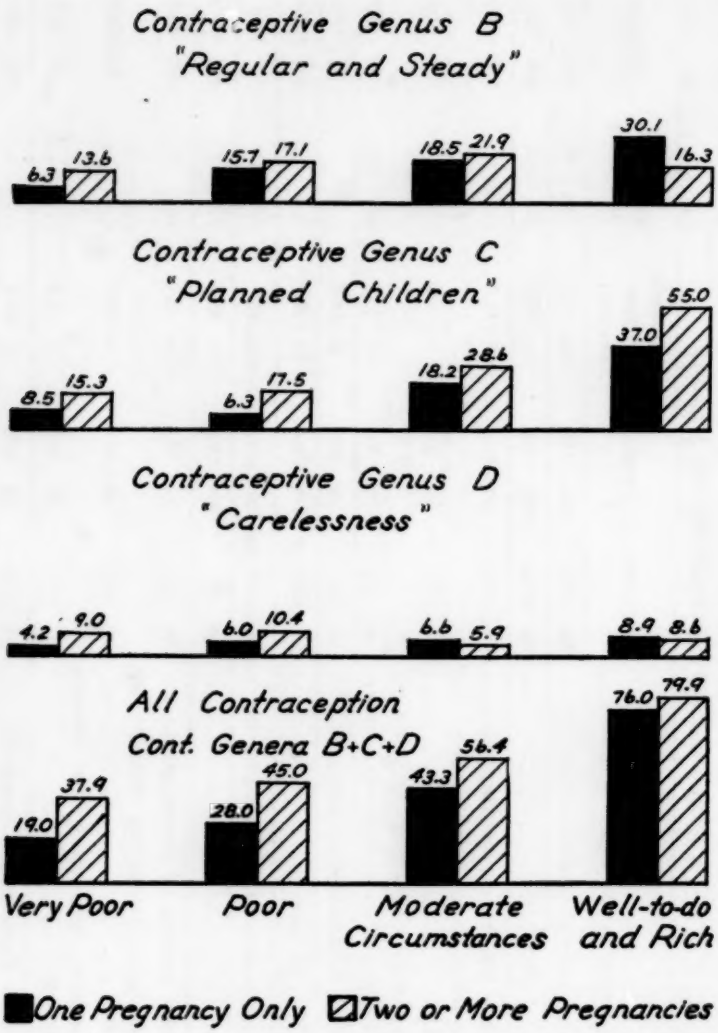

FIG. 5. PERCENTAGES OF WHITE WOMEN PRACTICING CONTRACEPTION IN RELATION TO (1) CONTRACEPTIVE GENUS, (2) ECONOMIC STATUS, AND (3) NUMBER OF PREGNANCIES EVER EXPERIENCED

The data of Table 9 will bear further analysis from another point of view. Broadly speaking, and with of course some individual exceptions, the conceptions among the women falling in Contraceptive Genus Group B occurred because of a combination of bad luck and bad management of contraceptive methods. Actually most of the "bad luck" was probably really bad management, due to general ignorance and lack of specific understanding of the biological principles involved in human reproduction. No great injustice will be done, I think, by classifying these women of Contraceptive Genus Group B as generally ignorant, who try to practice some kind of contraception regularly and faithfully but still keep on having babies. In contrast to these are the women in Contraceptive Genus Group C, who practice contraception intelligently, and by and large have babies only when they want them. Finally come the Contraceptive Genus Group D women, who as a class are the feckless ones; having the best of intentions about family limitation but failing from time to time to take the trouble, mainly through sheer carelessness, and consequently getting more babies than they want. These women are generally inclined to the opinion that contraceptive methods are no good, when the main fault is of course their own.

Now what of the proportions amongst all women making contraceptive efforts of these types of women in the several economic classes, and among primigravidae as compared with those who have experienced two or more pregnancies? The figures of Tables 9 and 10 do not answer these questions directly, because in those tables the percentages are based upon all the women in the sample, including those who do not practice contraception at all. Therefore, Tables 11 and 12 have been prepared. In appraising and discussing these tables it is again necessary to keep in mind the limitation imposed by the absolute smallness of some of the sub-classes.

Table 11 suggests a number of points of interest. In the first place the figures for the women in this sample who made contraceptive efforts of some sort suggest that general dumbness about contraception (and presumably other things) is no exclusive prerogative of any particular economic class. In fact it would seem to be rather evenly distributed amongst the women of this sample practicing contraception who had experienced but one pregnancy. Women who had experienced two or more pregnancies appear generally sharper-witted and more intelligent in their practice of contraception than those who had experienced but one, as might reasonably be expected *a priori*. This is especially true

of women in the Well-to-do and Rich class. The women in Contraceptive Genus Group C, who practice their contraception intelligently and for the most part effectively, are proportionately more numerous in the higher than in the lower economic classes, and except for the Very Poor class, are more numerous relatively among those in any given

TABLE 11

The Percentages of White Women Practicing Contraception Relative to (1) Contraceptive Genus, (2) Economic Status, and (3) Times Pregnancy Has Been Experienced

I. Women who had experienced only one pregnancy

CONTRACEPTIVE GENUS GROUP	VERY POOR (*Per cent*)	POOR (*Per cent*)	MODERATE CIRCUMSTANCES (*Per cent*)	WELL-TO-DO AND RICH (*Per cent*)	TOTALS (*Per cent*)
B. Regular and steady practice of contraception	33.3	56.1	42.8	39.6	46.2
C. Contraceptive practice intermittent mainly for planned children	44.4	22.4	42.0	48.6	36.9
D. Contraceptive practice intermittent for reasons other than planning	22.2	21.4	15.2	11.7	16.9
Totals	99.9	99.9	100.0	99.9	100.0
II. Women who have experienced two or more pregnancies					
B. Regular and steady practice of contraception	36.0	38.0	38.8	20.4	35.8
C. Contraceptive practice intermittent mainly for planned children	40.3	38.9	50.7	68.9	46.8
D. Contraceptive practice intermittent for reasons other than planning	23.7	23.2	10.5	10.8	17.4
Totals	100.0	100.1	100.0	100.1	100.0

economic class who have experienced two or more pregnancies than among the primigravidae. Again these are results which might reasonably have been expected *a priori*. Women who are careless about doing their contraception (Contraceptive Genus Group D) diminish in relative frequency as we go up in the economic scale, but are relatively about as numerous, on the whole, among those who have experienced two or

more pregnancies as among those who have had only one pregnancy. These results again seem about what might reasonably be expected *a priori*. Carelessness and indifference about so grave a matter as creating more human beings are probably matters of character, bred in the bone, and unlikely to be rapidly altered by experience.

Finally the last column of the table reveals a somewhat significant fact. It appears that if we take all the women together, regardless of both economic condition and experience in reproduction, somewhat less than half of the white women in this sample who practiced contraception did it intelligently, precisely, and effectively, using the word "effectively" in the sense of meaning the one-hundred-percent achievement of the objective which they (the women) set out to obtain by the practice of contraception. I make no comment on this result. It speaks for itself. In the Well-to-do and Rich class the case is different. There a much higher proportion of the women fell in our Contraceptive Genus Group C.

Table 12 corresponds to Table 11, but is for negro women.

From Table 12, considered in comparison with Table 11, it appears to be the case, always remembering that the numbers are small, that, of the women in each race practicing contraception, proportionately fewer among the negroes than among the whites did so with approximately complete intelligence and effectiveness (Cont. Genus Group C), but in the negroes of this sample just as in the whites, the proportion doing so increased with economic status. The percentages of negro women whose contraceptive practice fell short of perfection because of lack of intelligence in its application (Cont. Genus Group B) are, among those who had experienced two or more pregnancies, oddly similar to the corresponding percentages among the whites of Table 11. (The one-pregnancy negro women practicing contraception are too few in number to warrant any statement). The percentages of negro women in the sample whose contraceptive practices are defective primarily through carelessness are rather appallingly high, but seem to diminish with advancing economic status.

METHODS OF CONTRACEPTION USED

In this section we shall consider contraceptive species, that is the particular devices and methods used to prevent conception. As the data here are necessarily enormously complex and detailed it will be im-

TABLE 12

The Percentages of Negro Women Practicing Contraception, Relative to (1) Contraceptive Genus, (2) Economic Status, and (3) Times Pregnancy Has Been Experienced

I. Women who had experienced only one pregnancy

CONTRACEPTIVE GENUS GROUP	VERY POOR (*Per cent*)	POOR (*Per cent*)	MODERATE CIRCUMSTANCES (*Per cent*)	WELL-TO-DO AND RICH (*Per cent*)	TOTALS (*Per cent*)
B. Regular and steady practice of contraception	50.0	47.8	100	....	51.4
C. Contraceptive practice intermittent mainly for planned children	10.0	26.1	...	....	20.0
D. Contraceptive practice intermittent for reasons other than planning	40.0	26.1	...	....	28.6
Totals	100.0	100.0	100.0	....	100.0

II. Women who have experienced two or more pregnancies

B. Regular and steady practice of contraception	34.3	41.0	33.3	....	37.7
C. Contraceptive practice intermittent mainly for planned children	9.6	16.9	50.0	....	14.8
D. Contraceptive practice intermittent for reasons other than planning	56.2	42.2	16.7	....	47.5
Totals	100.1	100.1	100.0	....	100.0

possible to analyze them completely in this progress report. But I hope that the summary discussion of them will be of some use.

Table 13 shows, for the women in the sample who practiced contraception and had complete and intelligible records about it, the methods and devices used. The items in the table are arranged in descending order of frequency of usage among the whites. Some of the women (1136 whites and 145 negroes to be precise) had each used only one single method or device up to the time of record. The frequency of the devices as used by them stands in the first columns of figures in the two halves of Table 13. The remainder of the women "shopped around," as the phrase goes, in contraceptive practice; using now one method or device, now another, and sometimes two or more in combination. The

TABLE 13

Methods and Devices Used for Preventing Conception

CONTRACEPTIVE SPECIES	WHITES						NEGROES					
	Alone		In Combination with Other Methods		Total Usage		Alone		In Combination with Other Methods		Total Usage	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Condom	339	29.8	426	24.0	765	26.3	15	10.3	33	26.2	48	17.7
Douches alone—medicated	295	26.0	410	23.1	705	24.2	98	67.6	42	33.3	140	51.7
Coitus interruptus	217	19.1	370	20.8	587	20.1	4	2.8	21	16.7	25	9.2
Douches alone—water	197	17.3	263	14.8	460	15.8	18	12.4	10	7.9	28	10.3
Medicated vaginal suppositories or jellies	35	3.1	156	8.8	191	6.6	..	...	8	6.3	8	3.0
"Safe period"	20	1.8	70	3.9	90	3.1	3	2.1	9	7.1	12	4.4
Pessary with medicated jelly	18	1.6	24	1.3	42	1.4	5	3.4	..	...	5	1.8
Other methods	9	.8	22	1.2	31	1.1	2	1.4	3	2.4	5	1.8
Pessary alone	2	.2	19	1.1	21	.7	..	...	..	...	..	...
Pessary with douche	3	.3	14	.8	17	.6	..	...	..	...	..	...
Intra-uterine mechanical device	1	.1	4	.2	5	.2	..	...	..	...	..	...
Totals	1136	100.1	1778	100.0	2914	100.1	145	100.0	126	99.9	271	99.9

frequency of their employment of each designated method or device is shown in the second column of figures. Finally the last column of figures gives the sums of the other two.

The order of the figures in Table 13 is essentially the same as in the corresponding table in our first report (*loc. cit.*, p. 397). In the present sample of white women the condom comes first (because of its high degree of safety as the detailed records show) with the medicated douche and coitus interruptus closely following in relative popularity. The fact that the vast majority of these women have never been in contact with a birth control clinic or received really scientific birth control information of any sort is reflected clearly in Table 13. What these women, taken as a group, know about contraception is mainly what has been passed on to them by mothers, husbands, friends, or drug-store attendents, who in turn derived it from precisely the same kinds of sources, back to the debarkation at Ararat.

Oddly enough the 1136 (60.2 per cent) white women who stuck to one method or device alone, and the 750 women who instead followed the first part of the Pauline injunction to "try all things," furnish in the end extremely similar percentage distribution as to methods used.

Just as was the case in our first report the negro women show a relative frequency of usage of contraceptive methods and appliances rather widely divergent from that of the whites. Among the negroes douches are the outstanding method of choice, forming 62 per cent of the total usage, as against 40 per cent among the whites.

The general picture is of obviously still less precise and intelligent practice of contraception by the negroes than by the whites, even among those of both races who practice it at all.

Table 14 gives, for the white women, the distributions (absolute and relative) of contraceptive species according to contraceptive genus groups, for the total usage (alone or combined) of each method or device. The items are arranged in descending order for Contraceptive Genus Group C (contraceptive practice intermittent mainly for planned children).

It is apparent from Table 14 that the particular methods and devices for contraception employed by this sample of white women varied considerably according to their general mode of using them (contraceptive genus). The women falling in Cont. Genus Group C, who by and large do their contraception intelligently and carefully, intermitting it mainly only for planned children, favor most the condom.

TABLE 14

Methods and Devices Used for Preventing Conception by White Women, According to Contraceptive Genus Groups

CONTRACEPTIVE SPECIES	CONT. GENUS GROUP B		CONT. GENUS GROUP C		CONT. GENUS GROUP D	
	No.	%	No.	%	No.	%
Condom	227	19.6	408	32.5	130	25.9
Coitus interruptus	223	19.3	272	21.7	92	18.4
Douche alone—medicated	337	29.1	243	19.3	125	24.9
Douche alone—water	225	19.4	148	11.8	87	17.4
Medicated vaginal suppositories or jellies	64	5.5	103	8.2	24	4.8
"Safe period"	40	3.5	35	2.8	15	3.0
All other methods together	41	3.6	47	3.7	28	5.6
Totals	1157	100.0	1256	100.0	501	100.0

This is undoubtedly because it is the most reliable method known to these women, who for the most part have never had formal, scientific instruction in contraception. In this same Group C coitus interruptus comes next in frequency of usage, and this is followed in turn by medicated douches.

The women of Cont. Genus Group B (regular and steady practice, but failing mainly through ignorance and stupidity about contraception) rely most heavily upon medicated douches, with condom, coitus interruptus, and plain water douches following, each with about equal frequency.

The careless couples in Cont. Genus Group D depend about equally upon the condom and medicated douches, but less on the former and more on the latter than those in the Genus C group.

In Table 15 contraceptive species totals for white women are tabulated against economic status. The items are arranged in descending order of frequency in the "Well-to-do and Rich" column, that being the group in this sample which practices contraception most frequently, intelligently, and effectively.

Table 15 shows the manner in which economic position altered the details of contraceptive practice in this sample of women. The percentage using the condom rises steadily with advancing economic status. Coincidentally the percentage relying on medicated douches falls. As expensive as the condom is relatively, the Very Poor class in this sample

TABLE 15

Methods and Devices Used for Preventing Conception by White Women, According to Economic Status

CONTRACEPTIVE SPECIES	VERY POOR		POOR		MODERATE CIRCUMSTANCES		WELL-TO-DO AND RICH	
	No.	%	No.	%	No.	%	No.	%
Condom	52	22.3	266	22.7	290	27.5	157	34.7
Coitus interruptus	56	24.0	248	21.1	193	18.3	90	19.9
Douche alone—medicated	62	26.6	327	27.9	241	22.8	75	16.6
Douche alone—water	29	12.4	176	15.0	186	17.6	69	15.3
Medicated vaginal suppositories or jellies	18	7.7	67	5.7	74	7.0	32	7.1
"Safe period"	7	3.0	46	3.9	32	3.0	5	1.1
All other methods together	9	3.9	44	3.7	39	3.8	24	5.3
Totals	233	99.9	1174	100.0	1055	100.0	452	100.0

employed it to the extent of nearly a quarter of their total usage. Coitus interruptus tends to decrease somewhat in popularity with advancing economic status, but still remains one of the main resources in all groups.

PREGNANCY AND BIRTH RATES

In stating the main problem with which this investigation is concerned I said, in the first report, that one of them was to get light on the effectiveness of contraception *as practiced* in a defined sample of women. What I meant by this was that it seemed to me desirable to find out by how much the pregnancy rates and live birth rates were lower in groups of women practicing contraception in their own way—stupidly or intelligently, carelessly or precisely as the case might be—than they were in groups of women not practicing contraception at all. It is clear now that it was a mistake to use the words "effectiveness of contraception" in this connection. Quite apart from the fact that some persons whose emotions outrun their reason when contraception is under discussion chose to misunderstand or misconstrue what was meant, "effectiveness of contraception" were really question-begging words. I think that the problem I had in mind is nearly if not quite the most important still unresolved question connected with the problem of human population growth at this moment. It seems to me vastly more important than any such question as whether contraceptive device X is

effective *per se*. Without investigating the matter at all I know in advance that contraceptive device X, or Y, or Z may be 100 per cent effective when used by Mrs. Doe, and 100 per cent ineffective when used by Mrs. Roe. But what are the aggregate net consequences to the population of the contraceptive efforts of all the Mrs. Does and Mrs. Roes, taken together, as they actually operate in the sexual sphere?

Being now quite clear about the futility of ever attempting to talk about the "effectiveness of contraception" in so imperfect a world as this, I propose not to do so any more, but to confine the discussion to the following completely realistic question:

What are the pregnancy rates, and birth rates of defined groups of women endeavoring in various ways to practice contraception or not attempting to practice it at all, and how do these rates differ among themselves?

We shall now proceed to exhibit the data of the present sample arranged in such form as to show their bearing upon this question. The reader may then draw his own inferences in any direction he pleases as to what, if any, bearing the results may seem to have regarding the "effectiveness of contraception."

In the following discussion *pregnancy rate* means "number of pregnancies per 100 computed ovulations" as defined and described above (pp. 356-358 *supra*). *Live birth rate* means "number of live births per 100 computed ovulations."

Table 16 gives the mean pregnancy rates of the women in the present sample, together with their probable errors, tabulated by contraceptive genus groups and economic status. Thus in the upper left hand corner cell of Table 16 the figure 14.02 ± 0.62 means that the group of white married women in this sample who did not practice contraception and were very poor had an average pregnancy rate of just over 14 per cent.

Since Table 16 embodies the most interesting and significant results of the present report they are exhibited for the white women in graphic form in Figure 6. If the reader will study this diagram he may find it easier to grasp the general purport of the somewhat complicated figures of Table 16.

From Table 16 and Figure 6 the following significant results emerge:

1. The mean pregnancy rates of white women in this sample who had not practiced contraception at all (Cont. Genus Group A) are substantially similar in all economic status classes. The greatest difference

TABLE 16

Mean Pregnancy Rates per 100 Computed Ovulations in All Married Women in the Present Sample, by Contraceptive Genus Group and Economic Status

A. Whites

CONTRACEPTIVE GENUS GROUP	VERY POOR (*Per cent*)	POOR (*Per cent*)	MODERATE CIRCUM-STANCES (*Per cent*)	WELL-TO-DO AND RICH (*Per cent*)	TOTALS ALL WOMEN IN GROUP (*Per cent*)
A. No contraception	14.02±0.62	16.00±0.38	13.59±0.46	16.97±1.89	15.03±0.26
B. Regular and steady practice of contraception	8.77± .92	10.56± .50	8.63± .46	9.71± .88	9.60± .31
C. Contraceptive practice intermittent mainly for planned children	6.32± .40	7.27± .32	6.55± .27	5.16± .28	6.48± .16
D. Contraceptive practice intermittent for reasons other than planning	8.59±1.25	10.41± .65	9.67± .84	8.87± .89	9.85± .44
B. Negroes					
A. No contraception	14.03±0.74	14.67±0.71	18.24±2.55	.....	14.57±0.51
B. Regular and steady practice of contraception	10.42± .84	10.83±1.40	21.35±5.35	.....	11.20± .92
C. Contraceptive practice intermittent mainly for planned children	5.63± .58	9.25± .64	9.17±1.84	.....	8.30± .51
D. Contraceptive practice intermittent for reasons other than planning	9.22± .88	9.33± .86	.....*	.....	9.45± .62

* Only one woman in this class, with a pregnancy rate falling in the class 20.0-29.9 per cent.

between any two classes in average pregnancy rates is that between the Moderate Circumstances and the Well-to-do and Rich classes, and amounts to 3.38 ± 1.95, a statistically insignificant difference. The next greatest difference is that between the Moderate Circumstances class and the Poor. This amounts to $2.41 \pm .60$. This is probably a "statistically significant" difference, but seems absolutely too small in amount to have any particular biological significance. The Very Poor class has nearly the lowest mean pregnancy rate and the Well-to-do and Rich class the highest mean pregnancy rate among the white women not practicing contraception. While this result does not accord with popular preconceptions, and as had been noted the difference in any case is not statistically significant, its trend is in agreement in principle with the results of Edin [6] for the Stockholm population.

2. The white women belonging to the Cont. Genus Group C (contraceptive practice intermittent mainly for planned children) in this sample display an average pregnancy rate for the whole sample that is only 43.1 per cent of that shown by women not practicing contraception at all, a reduction of about 57 per cent. In the women of the Well-to-do and Rich class the Cont. Genus Group C mean pregnancy rate is only 30.4 per cent of that of the women in the same economic class not practicing contraception at all. This reduction of approximately 70 per cent in the average pregnancy rate associated with the relatively intelligent and careful practice of contraception is a very substantial lowering indeed. The mean pregnancy rate is lowered least (about 52 per cent) in association with Cont. Genus Group C in the Moderate Circumstances class, but the reduction is of approximately the same order as this in both the Very Poor and Poor classes.

3. Taking the white women in this sample as a whole group the mean pregnancy rates in Cont. Genus Groups B and D are roughly about 65 per cent of those exhibited by the women not practicing contraception at all, showing in other words a reduction of only about 35 per cent as compared with the 57 per cent shown by the women of Cont. Genus Group C. Careless and unintelligent contraceptive efforts, in short, have associated with them in this sample of women a smaller

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[6] Edin, K. A. Fertility in marriage and infantile mortality in the different social classes in Stockholm from 1919-1922. *Proc. World Population Conference. London* (Arnold) 1927. Pp. 205-207.

Id. The birth rate changes. Stockholm 'upper' classes more fertile than the 'lower.' *Eugenics Rev.*, Vol. 20, pp. 258-266, 1929.

reduction in the mean pregnancy rate than do careful and intelligent efforts.

4. The mean pregnancy rates of the white women in this experience are extraordinarily similar in each economic class, for the same contraceptive practices. To put it another way, if we were to connect the tops of each set of similarly hatched bars in Figure 6, we should have a series of nearly horizontal lines, only deviating from horizontality by amounts

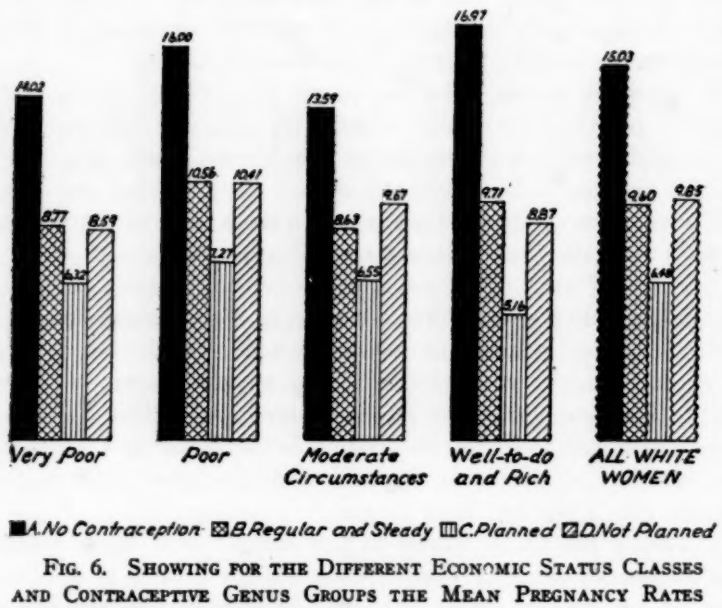

FIG. 6. SHOWING FOR THE DIFFERENT ECONOMIC STATUS CLASSES AND CONTRACEPTIVE GENUS GROUPS THE MEAN PREGNANCY RATES PER 100 COMPUTED OVULATIONS

generally well within the range of expected fluctuations of sampling. The horizontal lines would, however, be at different levels, associated with the modes of contraceptive practice which they designated. What this suggests biologically is that the innate natural fertility of these women is about the same in the different economic classes here distinguished, and that the differences in average *expressed* fertility observed in the different economic classes are due mainly to different degrees of artificial alteration of the innate natural fertility. On the

basis of the present material this conclusion seems clear and indubitable. I confess that it goes fundamentally contrary to the conclusions I had tentatively reached from earlier studies of the matter and from critically reading the literature. But I do not know that there has hitherto been available so considerable a body of reasonably accurate evidence, so pertinent to the elucidation of the point, or so cogently pointing in one direction and one direction only, as is that presented here. At the same time it will be well to reserve final judgment on the matter until the other four-fifths of our whole material has been tabulated.

5. The lower half of Table 16 dealing with the negro women shows in general, and within its limitations imposed by the smaller size of the sample, the same kind of relationships as those just discussed for the whites. The chief difference is that the lowering of the mean pregnancy rates among the women of Cont. Genus Groups B, C, and D, as compared with Group A, is generally not quite so large in amount as in the white women. But the outstanding and somewhat surprising result is the general likeness between the white and the negro tables. This is so marked that it seems unnecessary to display the negro figures graphically.

6. Comparing negro and white groups as wholes it appears that the negro women who did not practice contraception at all in this sample have a mean pregnancy rate almost identical with that of the white women in the same category. The mean rate for the negro women is actually slightly lower than that for the whites but no significance is to be attached to the slight difference. The average negro rates do, however, lend additional support to the view expressed above that these data suggest that innate natural fertility uninfluenced by artificial alterations appears to be about the same for all groups of women into which this material has been divided. If substantiated by further data this would mean that the reason for the frequently observed higher birth rates of negroes might be sought in the fact that as a racial group they practice contraception much less frequently than whites, and somewhat less intelligently and carefully when they do practice it.

7. The lowest average pregnancy rate among negro women not practicing contraception at all is in the Very Poor Class, and the highest in the Moderate Circumstances class. This agrees in principle with the findings in the whites, but the difference is not statistically significant having regard to its probable error.

TABLE 17

Mean Live Birth Rates per 100 Computed Ovulations in All Married Women in the Present Sample, by Contraceptive Genus Group and Economic Status

A. Whites

CONTRACEPTIVE GENUS GROUP	VERY POOR (*Per cent*)	POOR (*Per cent*)	MODERATE CIRCUMSTANCES (*Per cent*)	WELL-TO-DO AND RICH (*Per cent*)	TOTALS ALL WOMEN IN GROUP (*Per cent*)
A. No contraception	13.20±0.63	15.09±0.37	12.72±0.46	16.55±1.90	14.16±0.26
B. Regular and steady practice of contraception	8.09± .93	9.76± .49	7.42± .37	9.26± .89	8.70± .28
C. Contraceptive practice intermittent mainly for planned children	5.85± .37	6.32± .31	5.96± .26	4.54± .21	5.77± .15
D. Contraceptive practice intermittent for reasons other than planning	7.69±1.26	9.77± .64	8.84± .82	7.58± .88	9.07± .43
B. Negroes					
A. No contraception	12.75±0.72	13.60±0.70	17.44±2.59	.....	13.42±0.50
B. Regular and steady practice of contraception	8.75± .71	8.44±1.03	20.00±5.62	.....	9.14± .73
C. Contraceptive practice intermittent mainly for planned children	4.38± .58	8.50± .61	9.17±1.84	.....	7.50± .51
D. Contraceptive practice intermittent for reasons other than planning	8.78± .79	8.72± .86	.....*	.....	8.94± .59

* Only one woman in this class, with a birth rate falling in the class 20.0-29.9 per cent.

TABLE 18

Mean Pregnancy Rates per 100 Computed Ovulations in White Married Women in the Present Sample, by Contraceptive Genus Group and Economic Status

I. Women who had experienced only one pregnancy

CONTRACEPTIVE GENUS GROUP	VERY POOR (*Per cent*)	POOR (*Per cent*)	MODERATE CIRCUMSTANCES (*Per cent*)	WELL-TO-DO AND RICH (*Per cent*)	TOTALS ALL WOMEN IN GROUP (*Per cent*)
A. No contraception	25.20±1.53	24.84±0.74	19.73±0.81	28.11±3.61	23.26±0.52
B. Regular and steady practice of contraception	19.44±4.78	16.61±1.24	12.28±1.00	12.28±1.42	14.33± .71
C. Contraceptive practice intermittent mainly for planned children	8.54±1.28	10.06±1.25	9.00± .68	5.97± .49	8.44± .45
D. Contraceptive practice intermittent for reasons other than planning	7.69±1.26	9.77± .64	8.84± .82	7.58± .88	9.07± .43
II. Women who had experienced two or more pregnancies					
A. No contraception	8.38±0.30	9.52±0.25	7.32±0.26	7.68±0.98	8.69±0.16
B. Regular and steady practice of contraception	6.85± .46	7.50± .33	6.25± .33	5.96± .60	6.87± .21
C. Contraceptive practice intermittent mainly for planned children	5.85± .39	6.71± .21	5.33± .18	4.78± .34	5.77± .14
D. Contraceptive practice intermittent for reasons other than planning	6.29± .41	8.10± .57	7.89± .86	7.22± .86	7.72± .38

8. Taking the negro group as a whole, the average pregnancy rate is below that of the women not practicing contraception at all, by about 23 per cent in those belonging to Cont. Genus Group B; by about 43 per cent in those belonging to Cont. Genus Group C; and by about 35 per cent in those belonging to Cont. Genus Group D.

Table 17 gives the mean live birth rates, as defined above, for this material, tabled in precisely the same manner as the mean pregnancy rates of Table 16.

Table 17 brings out no point of principle differing in any essential way from those seen in Table 16. The lower values of the live birth rates below the pregnancy rates are, of course, due to what I have called reproductive wastage, that is to the losses reflected in abortions, miscarriages, and still births.

It has been shown in Table 9 *supra* that a high proportion of the women in this sample of material had at the time of record been pregnant only once, and that the percentage of those who had not practiced contraception was considerably higher among these primigravidae than among those who had been pregnant two or more times. It is therefore desirable to examine the mean pregnancy rates of these two groups of women.

Tables 18 and 19 present the data in the same form as in Table 16. Table 18 deals with white women and Table 19 with the negroes.

Table 18 shows definite similarities to, as well as marked differences from Table 16. It is in the first place clear that the relatively high average pregnancy rates of Table 16 are primarily the resultant of the fact that this sample of women delivered in hospitals contains a high proportion of primigravidae. As had been suspected even before this investigation was begun, one of the commonest immediate results of marriage is a pregnancy.

But it is equally apparent that when our material is divided as in Table 18 no one of the basic results derived from Table 16 is essentially altered. It still appears to be the result that, whether we deal with primigravidae or more sexually experienced women, innate natural fertility seems to be about the same in all of our four economic classes, and is only altered by artificial means addressed to the attainment of that result. Furthermore it appears that in both primigravidae and in women who have experienced two or more pregnancies those who do their contraception according to Cont. Genus Group C have lower mean pregnancy rates than any other class in this experience.

TABLE 19

Mean Pregnancy Rates per 100 Computed Ovulations in Married Negro Women in the Present Sample, by Contraceptive Genus Group and Economic Status

I. Women who had experienced only one pregnancy

CONTRACEPTIVE GENUS GROUP	VERY POOR (*Per cent*)	POOR (*Per cent*)	MODERATE CIRCUMSTANCES (*Per cent*)	WELL-TO-DO AND RICH (*Per cent*)	TOTALS ALL WOMEN IN GROUP (*Per cent*)
A. No contraception	27.21±2.35	24.43±1.79	22.33±3.36	.....	25.31±1.34
B. Regular and steady practice of contraception	10.00±2.52	16.82±4.43	.....*	.....	13.97±3.04
C. Contraceptive practice intermittent mainly for planned children	.....	10.83±1.03	.....	.....	10.83±1.03
D. Contraceptive practice intermittent for reasons other than planning	15.63±4.19	19.17±4.38	.....	.....	17.75±3.14

* Only one case, pregnancy rate in class 0-4.9.

II. Women who had experienced two or more pregnancies

A. No contraception	9.80±0.47	10.16±0.48	14.41±3.69	.....	10.15±0.36
B. Regular and steady practice of contraception	10.50± .87	8.90±1.07	27.50±5.21	.....	10.12± .85
C. Contraceptive practice intermittent mainly for planned children	5.63± .58	8.57± .78	9.17±1.84	.....	7.70± .56
D. Contraceptive practice intermittent for reasons other than planning	8.60± .84	7.64± .44	.....*	.....	8.38± .51

* Only one case, pregnancy rate in class 20.0-29.9.

Coming now to details it appears that among the primigravidae the highest mean pregnancy rate among those not practicing contraception at all is among the Well-to-do and Rich in this material. But among those who have been pregnant two or more times and have not practiced contraception it falls upon the Poor class. The probable errors, however, are so large especially for the primigravidae that these differences cannot be regarded as statistically significant.

Taking all the white women together, regardless of economic status, the primigravidae who fall in Cont. Genus Group C (intermittent mainly for planned children) have a mean pregnancy rate some 64 per cent lower than that of women who do not practice contraception at all. The corresponding figure for women who have been pregnant two or more times is about 34 per cent. This result suggests that possibly artificial interference with innate natural fertility tends to approach asymptotically a limit higher than zero. That is, apparently normal people do want *some* children, odd as that idea may seem to some persons. In the case of women belonging to the Well-to-do and Rich class the mean pregnancy rate for primigravidae belonging to Cont. Genus Group C is about 79 per cent lower than primigravidae in the same economic class not practicing contraception at all. The corresponding percentage lowering of the pregnancy rates for women who had experienced two or more pregnancies is 38 per cent.

Table 19 is the same as Table 18, but for negro women.

Table 19 shows the same general characteristics as Table 18, with only such differences as accord with what we have learned earlier about the negroes in this sample. It is again noteworthy, however, that the negro primigravidae not practicing contraception exhibit mean pregnancy rates generally not significantly different from the corresponding group of whites.

It seems unnecessary to publish the live birth rate tables corresponding to Tables 18 and 19. They show only such differences from Tables 18 and 19 as are consequent upon reproductive wastage. Considerations of space and expense compel their omission from this progress report.

SUMMARY AND DISCUSSION

This paper presents a report of progress on an extensive investigation of the prevalence of contraceptive efforts among a defined sample of American women, not selected with reference to their interest in birth control. The present report deals with about one-fifth of the total

material that will eventually be analyzed. The present sample consists of 4945 married women, of whom 84.5 per cent are whites. Seventy-five per cent of the whites and 80 per cent of the negroes belong to the four states Illinois, Maryland, Pennsylvania and New York. The remainder are scattered among nine other states. The economic status of these women is described, as is also the occupational status of the husbands. In religion 40 per cent of the whites are Catholic and 15 per cent Jewish. Nearly all are urban dwellers. Of the white women 61.6 per cent had never got beyond elementary schools. The same was true of 69.9 per cent of the negro women. Only a very small number of women (fewer than one per cent of the whites, and still fewer among the negroes) appear ever to have had any formal or scientific instruction in the principles or practice of contraception, or contact with a birth control clinic. The total experience includes 17,505.3 person-years exposure to risk of pregnancy. The mean duration of marriage in the whites was 5.72 years, and in the negroes 6.44 years. The white women in the sample had, on the average, spent 38.6 per cent of their whole married lives in the business of being pregnant and bearing children. The negro women had spent 42.5 per cent of their married lives in the same way.

The more important results regarding *prevalence of contraceptive efforts* are:

1. The prevalence of contraceptive practices among the white women in this sample is definitely and positively associated with economic status. The percentage of white women practicing contraception rises from 32.7 among the Very Poor; to 38.8 among the Poor; to 50.6 among those in Moderate Circumstances; and to 78.3 among the Well-to-do and Rich. The percentage of negro women practicing contraception is 24.0 among the Very Poor and 27.8 among the Poor.

2. The percentage of women not practicing contraception is higher among the primigravidae in this sample than among those who have been pregnant two or more times. This is true for both whites and negroes and in all four economic groups. The differences are largest in the Very Poor class, and, in the whites, smallest in the Well-to-do and Rich class.

3. Among white women in this sample who made some sort of contraceptive effort, somewhat fewer than one-half, regardless of both economic status or duration of marriage and consequent number of experienced pregnancies, did their contraception intelligently, precisely,

and "effectively," using effectively to mean complete achievement of the object which they set out to attain by the practice of contraception. Among these white women practicing contraception, taken as a whole group, 46.2 per cent of the primigravidae and 35.8 per cent of those who had experienced two or more pregnancies had more pregnancies than they desired primarily through lack of intelligence about the principles of successful contraception. Finally, of the whole group of white women making contraceptive efforts 16.9 per cent of the primigravidae and 17.4 per cent of those who had experienced two or more pregnancies had more pregnancies than they desired primarily through carelessness in the usage of contraceptive methods and appliances.

4. But in the Well-to-do and Rich classes among the white women making contraceptive efforts of any sort, 48.6 per cent of the primigravidae and 68.9 per cent of those who had experienced two or more pregnancies did their contraception with considerable precision, and mainly had only as many pregnancies as they wanted, and when they desired them.

5. Among the negro women in this sample making any contraceptive efforts the percentage who did so with considerable precision and mainly had only planned and wanted pregnancies is low, and the percentage of those whose contraception failed because of carelessness is high.

The more important results regarding *methods of contraception* used are:

6. Of the 1886 white women in this sample who had practiced some sort of contraception, 1136 or 60.2 per cent had used in their whole marital experience but one single method or device alone, whereas 750, or 39.8 per cent, had tried two or more methods or devices, successively or in combination. The corresponding percentages for negro women are 73.6 and 26.4.

7. Among the white women practicing contraception 86.4 per cent of it was accomplished by the use of the condom, or coitus interruptus, or medicated douches, or plain water douches, either alone or in some combination. The corresponding percentage for the negro women was 88.9. It is thus evident that among the women of the sample, mostly without sound scientific instruction in contraception, the more modern methods found relatively little usage.

8. Among those in the group practicing contraception intelligently and having only wanted children, the condom stood first in popularity because the most reliable method known to them. Among those whose

contraceptive attempts failed of complete effectiveness, through ignorance of its principles, medicated douches were highest in popularity. As expensive a means of contraception as the condom is relatively, the Very Poor and Poor classes in this sample employed it to the extent of nearly a quarter of their total usage. This again is chiefly because of its supposed greater reliability.

The more important results as to *changes in pregnancy and birth rates associated with contraceptive practices* are:

9. The mean pregnancy rate (pregnancies per 100 computed ovulations) of white women in this sample who had not practiced contraception at all are substantially similar in all four economic classes, ranging from 13.59 ± 0.46 for the Moderate Circumstances class to 16.97 ± 1.89 in the Well-to-do and Rich class.

10. The white women who practiced contraception most intelligently and precisely, intermitting it mainly only for planned and wanted pregnancies, exhibited a mean pregnancy rate only 43.1 per cent of that of the women not practicing contraception at all, a reduction of about 57 per cent. The corresponding reduction among women of the Well-to-do and Rich class is approximately 70 per cent.

11. Careless and unintelligent practice of contraception shows, as would be expected, lower associated reductions in the pregnancy rates in all economic classes.

12. The mean pregnancy rates of the white women in this experience are extraordinarily similar in each economic class, for the same contraceptive practices. This leads to the tentative conclusion (to be tested by further data) that the innate natural fertility of these women is about the same in the different economic classes here distinguished, and that the differences in *expressed* fertility in the different economic classes are due mainly to different degrees of artificial alteration of the expression of innate natural fertility.

13. The negro women in the sample show essentially the same kind of relationships between contraception and mean pregnancy rates as those described above for the whites. The chief difference is that their contraceptive practices did not have associated with them quite so large reductions in the pregnancy rates.

14. The mean pregnancy rates for negro women not practicing contraception at all are very closely similar to those for the corresponding group of whites, indicating a similar innate natural fertility.

15. Results 9 to 14 above are, in principle and with only the numerical differences due to reproductive wastage by miscarriages, abortions, and still-births, the same for live birth rates calculated on the same basis (live births per 100 computed ovulations).

The above 15 numbered paragraphs state only a part of the results set forth in the body of this report, but they sufficiently indicate the general trend. The general picture is of a state of affairs where a high proportion of the economically most fortunate classes are practicing contraception with a relatively high degree of precision and intelligence, producing mainly only as many babies as they want and when they want them. On the other hand the less and particularly the least fortunate economic classes, in this material certainly, are to a much smaller extent making any attempt to practice contraception at all, and of those who are making the attempt the proportion who are doing so intelligently and precisely is also smaller. Our detailed records indicate clearly that *this is due primarily to ignorance of contraceptive methods and technique,* rather than to a desire to have large families. Hundreds and hundreds of the women in this sample who do not practice contraception are pleading for information and instruction so that they may. A more perfect illustration than that afforded by the figures of this report would be hard to find of the element of truth embodied in that plaintive ballad whose refrain states that:

> It's the *rich* what 'as the pleasure;
> It's the *poor* what gets the blime!

It seems to me plain, though I admit that others whom I greatly respect hold, or at least have held, different views, that all the eugenic propaganda and pleading ever heard of or conceivable is not going substantially to increase the birth rates among the more fortunate economic classes, who also are, by and large, the more intelligent classes. They are at least intelligent enough to have a concept which they regard as enlightened self interest, and to act according to it. It seems silly to suppose that any sort of propaganda is going to result in a significant increase in the birth rate among these classes.

On the other hand the economically unfortunate classes also have a concept which they too regard as enlightened self interest. The degree of enlightenment involved in it seems to me to be on the whole definitely smaller than in the other group of which we have just been speaking. But about this there is this to be said: that in any case the level of intelligence or enlightenment of the economically less fortunate classes,

wherever it may be placed, is at least sufficiently high, on the testimony of the data of this report, to make many of them wish to practice contraception effectively who are not now doing so.

The logic of our results would seem to point clearly and unequivocally to the probability that prompt removal of all legal restriction to the free dissemination of contraceptive information, and of barriers to the unrestricted distribution of contraceptive devices, would tend to have the effect of bringing the differential fertility of social classes more nearly into balance again. Whether this would be a "good" or "desirable" thing to do is a matter of opinion, to which our results *per se* make no contribution. Therefore that question will not be discussed. But it seems clear that if restrictions upon the dissemination of contraceptive information and advice were removed, it might somewhat lighten the burden of poverty and unemployment with which our children and grandchildren bid fair to be faced. After all it should not be forgotten that even though the "universe" may conceivably be expanding as some astronomers tell us it is, certainly this earthly globe on which we live is doing nothing of the sort. And yet each year there are more human beings on it than there were the year before. All of these human beings desire not only to live but to enjoy life. The more of them there are the more difficult it is likely to be to satisfy either of these desires, unless and until man's control of nature and of himself keeps better in step with his biological reproductivity than has been the case in the past.

NOTES

NOTE ON THE STATISTICAL SIGNIFICANCE OF THE DIFFERENCE OF TWO SERIES OF COMPARABLE MEANS*

NOT infrequently workers in the field of physical anthropology are faced with the problem of determining whether or not a series of averages or means derived from subgroups of one population are significantly different from averages derived from similar subgroups of a different population. For example, the inquiry may be made: Are the averages of weights of rural elementary school children of different ages significantly different from similar averages for city school children? The usual method of handling such a problem consists of making tests of the statistical significance of the differences between comparable subgroups of the two populations. Thus it may be determined whether or not the average weight of 6-year-old rural school girls is significantly different from that of 6-year-old city girls; whether the average of the rural 7-year-olds is different from the city 7-year-olds, and so on. In one case the difference between the two populations may be large and the averages of each pair of subgroups may be found to differ significantly. In another case, while the differences may be small and statistically insignificant, nearly all of the averages of one population may be greater or smaller than those of the other. In the latter case it is often desirable to accumulate all of the available evidence in order to answer the question: What is the probability, if there are no actual differences between the averages of the two populations, that the series of observed differences would arise as a result of random sampling? Various methods for accumulating evidence of this kind into a single statement of probability are well known to mathematical statisticians. However, the frequency with which many workers fail to make use of such methods, together with the fact that one simple test may be made in a few minutes, once the statistical significance of the subgroups is known,

* From the Department of Biostatistics (Paper No. 193), The Johns Hopkins School of Hygiene and Public Health, Baltimore, Md.

makes it appear desirable to call particular attention to this simple test. Briefly, and without going into the details of the derivation of the formulas, the test[1] consists of the determination of whether or not the *mean* of the ratios, $\frac{\text{Difference}}{\text{Probable error of difference}}$, obtained in testing the significance of the differences of the separate subgroups, is significantly greater or less than zero. This mean (taking account of the signs of the numerators of the ratios) will tend to approach zero if the differences between the subgroups of the two populations have arisen wholly as a result of random sampling. The probable error of the distribution of the ratios, because each difference has been expressed on the scale of its own probable error, will theoretically equal one (1). The probable error of the mean ratio, by the usual formula, will equal

$$\frac{\text{Probable error of distribution}}{\sqrt{n-1}} \quad \text{or} \quad \frac{1}{\sqrt{n-1}}$$

where n is the number of ratios or pairs of subgroups. The test of the statistical significance of the deviation of the mean ratio from zero may be obtained from tables of the normal probability integral, entering the tables with the value,

$$\frac{\text{Mean ratio}}{\text{Probable error of mean ratio}} = \frac{\text{Mean ratio}}{\frac{1}{\sqrt{n-1}}}.$$

Material published in a recent paper[2] may be conveniently used to illustrate the method. The appropriate data are shown in the following table where the average weight of mountain school girls, and the average weight of another group of southern school girls are given, respectively, in the separate age classes from 7 through 15 years. In addition to the two series of averages, there are given the probable errors of the averages for the different age groups of both populations, the differences between the averages of the age groups, and the ratios,

$$\frac{\text{Difference of averages}}{\text{Probable error of difference}}.$$

[1] A very simple explanation of the method, together with the derivation of the formulas, may be found in the following: Lundborg, H., and Wahlund, S., (1933). The Race Biology of the Swedish Lapps. Part I, General Survey, Prehistory, Demography, Future of the Lapps, pp. 55-56, *Uppsala.*

[2] Wheeler, Lester R., (1933). A comparative study of the physical status of East Tennessee mountain children. HUMAN BIOLOGY, Vol. 5, pp. 706-721.

AGE (*years*)	7	8	9	10	11	12	13	14	15
Aver. weight mtn. girls (*Kg.*)	22.2	24.7	27.0	30.4	32.9	35.3	42.9	46.0	48.1
Aver. weight southern girls (*Kg.*)	21.9	23.8	26.3	29.0	31.9	36.2	40.7	45.1	48.8
Diff. (average of southern girls — average of mountain girls) (*Kg.*)	—0.3	—0.9	—0.7	—1.4	—1.0	+0.9	—2.2	—0.9	+0.7
P. E. aver. mountain girls (*Kg.*)	.30	.28	.33	.39	.44	.52	.70	.74	.66
P. E. aver. southern girls (*Kg.*)	.12	.07	.08	.10	.11	.14	.16	.19	.20
$\frac{\text{Diff. of averages}}{\text{P. E. difference}}$	—1.0	—3.1	—2.1	—3.4	—2.2	+1.6	—3.0	—1.2	+1.0

$$\Sigma\left[\frac{\text{Difference of averages}}{\text{P. E. difference}}\right]_{n} = \text{Mean ratio} = M = -1.48$$

$$P.E._M = \frac{1}{\sqrt{n-1}} = .353$$

$$\frac{M}{P.E._M} = \frac{1.48}{.353} = 4.2$$

$$P = .005$$

It will be observed that the average weights of girls from the mountain districts are greater than those for the other southern girls, except at 12 and 15 years. Also it will be noted that the differences between the averages are not statistically significant (three times the probable error), except at 8, 10, and 13 years. Viewing these observations as a whole, one is inclined, on general grounds however, to believe that the mountain girls are actually slightly heavier, despite the lack of completely consistent and significant differences.

It is pertinent, therefore, to determine the probability for the occurrence of the whole series of observed differences. According to the method outlined above, it is necessary first to obtain the mean of the ratios, $\frac{\text{Difference of averages}}{\text{Probable error of difference}}$. In the table, this is the sum of the row of numbers, $\frac{\text{Difference of averages}}{\text{P. E. of difference}}$, divided by 9, or —1.48. The theoretical

probable error of the mean ratio equals $\frac{1}{\sqrt{n-1}}$, where n is the number of ratios of pairs of averages. In the illustration cited, the probable error of the mean ratio equals $\frac{1}{\sqrt{8}}$, or .353. The final statement of the probability for the occurrence of the whole series of observed differences is found from the normal probability table, entering the table with the value $\frac{1.48}{.353}$ or 4.2. In this way it is found that P equals .005, or that there are only 5 chances in a thousand that the observed differences would occur as a result of sampling variation, and it may be concluded that the mountain girls are significantly heavier than the other southern girls.

Thus, through the use of this simple test, it is possible to make a definite judgment as to the differences between two populations. In general, the method is applicable to any problem in which it is desirable to compare subgroups of different populations. A similar procedure may be used for the comparison of medians, standard deviations, and other statistical constants, bearing in mind that this method cannot be employed unless it is justifiable to make use of the probable error in testing the significance of the difference of the separate subgroups and that a significant difference may not be revealed when there are certain types of trends of the difference of the subgroups.

CARROLL E. PALMER

A THIRD ASPECT OF GROWTH

GROWTH[1] is commonly conceived of as a process of augmentation and differentiation. In the study and analysis of structural growth this concept has been fairly satisfactory. In any case, those most eminent in the science have made no protest. However, when behavior growth is studied it is found impossible to reduce behavior changes simply to augmentation and differentiation. Another concept such as conjugation or integration is neces-

[1] The term growth as used here designates all the more or less progressive and permanent changes of an organism. Development is synonymous with growth.

sary for an adequate interpretation of the phenomena observed. Even in a 42 day period the behavior growth of an infant between 46 and 52 weeks of age has been seen to involve changes in integration of activities[2] when, for the first time, she crept and *at the same time* retained her cube; when she extended the cube to the examiner *with vocalization;* and when she released one cube *on top of another.*

Development in behavior is not simply more and more similar activity, and particularization of activity but in addition and above all it is a constantly changing synchronizing process. It is this last aspect which is most important for the most mature level of functioning of the organism. Again to cite from infant behavior, the development of ocular fixation and pursuit, uncoördinated with the development of grasping, would never explain or permit reaching and prehension. The development of the pincer grasp from the scissors type of grasp may be explainable in terms of differentiation but prehension is something more than seeing an object and grasping an object placed in the hand. It is a synthesis of these two behaviors, an entirely different process from differentiation. Similar countless examples could be offered not only from infant behavior but from the behavior growth of other living organisms.

When the importance of this concept for the understanding of behavior growth is realized one wonders if it is not also inherent in structural growth. Certainly the character of the differentiation plays an important part in further differentiation. Recent researches on the development of transplanted tissues show that both foreign body and host may be influential regarding resulting development. Integration changes must play their part here too. Certainly anyone who has seen the excellent cinema record of the cell division, or of the first fetal heart beat of the chick must be impressed with the conjugational aspects of the development of both structure and function.

One may ask why is it important that we have concepts of growth. Why not just study growth? Our concepts determine our researches, our methods of investigation, our analysis and our attempts at measurement. More than epistemology is involved. In spite of the fact that integration is a hackneyed concept it is necessary, I think, to point out

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[2] Thompson, Helen, The Growth and Significance of Daily Variations in Infant Behavior, *Jour. Genetic Psychol.,* Vol. XL, No. 1, pp. 16-36, 1932.

the inadequacy of designating the growth process simply as one of augmentation and differentiation, and to recognize fully, whatever it is called, the further equally important aspect, conjugation or integration.

HELEN THOMPSON, PH.D., RESEARCH ASSOCIATE,
THE CLINIC OF CHILD DEVELOPMENT,
YALE UNIVERSITY.

RECENT LITERATURE

USEFUL IN THE STUDY OF HUMAN BIOLOGY

In this department will be noticed the books and reprints which are currently received at the Editorial Office. Publications intended for notice here should be addressed to Dr. Raymond Pearl, Department of Biology, School of Hygiene and Public Health, 1901 East Madison Street, Baltimore, Maryland, U. S. A.

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